

AN ATLAS OF
INSECT
MORPHOLOGY

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PREFACE

The principal aim of the present atlas is to survey insect morphology as far as the imago's exoskeleton is concerned. Many books of a similar nature have appeared in the past, and though the subject is the same the treatment of our attempt is different.

Most authors on insect morphology wrote descriptive works with a wealth of information hidden in the text thereby necessitating that students interested in the superficial characteristics of a particular insect group should delve into voluminous books to select terminology for their special purpose. But since insects are so extremely variable in form, in the majority of cases the selection of the precise term to describe any particular feature presents quite a task. To further aggravate the problem many an author coined new words either to substitute older ones or to provide a name for a skeletal characteristic previously unnamed. Thus, there are scarcely any two works using identical terminology.

One of the most comprehensive works in the recent literature is the two volumes (the head and the thorax) of Matsuda, whose great merit is that he attempted to homologize insect morphology. Even so his books are basically descriptive presenting at the same time a string of arguments and counter-arguments to support the validity of one or another technical term, in many instances coining new ones, thereby once again rendering orientation difficult.

The majority of the figures have been adapted from literature sources, on the other hand, many have been newly designed, especially when illustrating homologized body regions: the reason for this approach was to convey the meaning in a simplified form.

The Authors

INTRODUCTION

The structure of this atlas illustrating the general external morphology of the fully developed insect is quite simple. With the use of a wide selection of literature the authors have endeavoured to gather all relevant material, falling back on homologization where it was deemed necessary, to introduce students of morphology into the realm of common external characteristics of insect imagoes.

The external morphology of the insect is treated in parts broken down according to the main body regions shown in 756 line drawings. The parts include, in order, the homologized skeletal elements, the various appendages, the superficial apertures of the body as well as the copulatory organs as distinct from abdominal organs. The simple drawings fulfil one sole purpose: illustration, since in several instances we may encounter figures in which are illustrated all the principal skeletal features, obviously in nature such a form is quite unthinkable. Our purpose in doing this was to save place. Obviously when it has been thought necessary, though without the claim of completeness and without regard to special order, the authors have presented the principal types which diverge from the basic form. In other words, the principal types were to a certain extent designed to loosen up the otherwise strictly homologized and schematically represented figures. Even in the case of the principal types the authors declined to restrict any particular feature to one species, thus, in every instance the accepted lowest category was the genus, the highest the order. The figures in the plates are more or less related to one another, on the other hand, occasionally morphologically quite alien parts are placed side by side.

Subsequent to the atlas proper an Appendix is given which illustrates, in over one hundred figures, the superficial characteristics of the insect body. Illustrations here include the microsculpture, the noncellular, the unicellular and the multicellular external and internal cuticular processes or formations, e.g. spine, bristle, hair, suture, cavity, etc. Furthermore, one finds illustrations of the spiracle, the auditory organ, the form of segmentation and articulation, the openings of various glands and the wing pattern.

In order to identify any particular part of the body with certainty the terminology is given in Latin. In several cases decisions had to be made after careful consideration of the available terms. In accepting a term into the atlas our governing principle was to choose the most commonly used descriptive word or expression whose functional content is most readily conceivable among the host of synonyms. Here the authors would like particularly to stress that when a name was selected to describe a bodily feature, in fact no overruling decision had been made for the supremacy of that one term, thus, all the other perhaps similarly frequently used names may equally be correct, and the authors had no intention of suppressing any one word or expression. It is all the more important to bear this in mind since many specialists working on one particular group of insects adopted a terminology of their own and these terms have a standing of several decades or perhaps

even of two centuries. However, some of these terms (given in italics) had to be included in the indexes to help those trying to solve a problem solely by means of the indexes. All the special expressions would in fact need a separate volume. The validity of many a word describing the very same bodily part is unquestionable, since an anatomical or morphological term may be formed in several ways. Among these the commonest is the single-word expression, thus, the foot-stalk of the maxilla is the *stipes*. In other cases, a concept may be approached from several other directions, all being correct, e.g. between the cheek and the *pleurostoma* a thin line is present, this we might call the lower margin of the cheek (*clavus genalis ventralis*), or the upper margin of the *pleurostoma* (*clavus pleurostomatalis dorsalis*), but we are aware of another, somewhat vague expression: *linea marginalis*, when the accepted and currently used term is *sutura subgenalis*. Of course, all these variations will not figure in the indexes as synonyms owing to lack of space. A general expression, e.g. the maxilla (Fig. 61), refers not to the maxilla of a butterfly, of a beetle, of a dragonfly, but that of *an insect*, since it is homologized. Also the present authors deferred from using the word, e.g. *pars*, and its corresponding synonyms, because it was restricted to one particular conceptual sphere, and all the more so did the authors bear this in mind since in the literature these words are employed rather arbitrarily. Thus, our Fig. 61 depicting the maxilla with its movable parts may equally be called *pars maxillaris*, or *area maxillaris*, or *regio maxillaris*.

With a view to completeness the authors endeavoured to illustrate and thereby to introduce as many bodily parts and their respective current morphological terms as were possible. However, again owing to shortage of space, certain obvious analogies were not given despite the fact that they exist. For example, when a given part, say a plate, was further differentiated, and it had a process at its front margin, it appeared as the anterior process of the plate; if it also had a posterior process it was either illustrated and given a name, or it was left wholly unnamed.

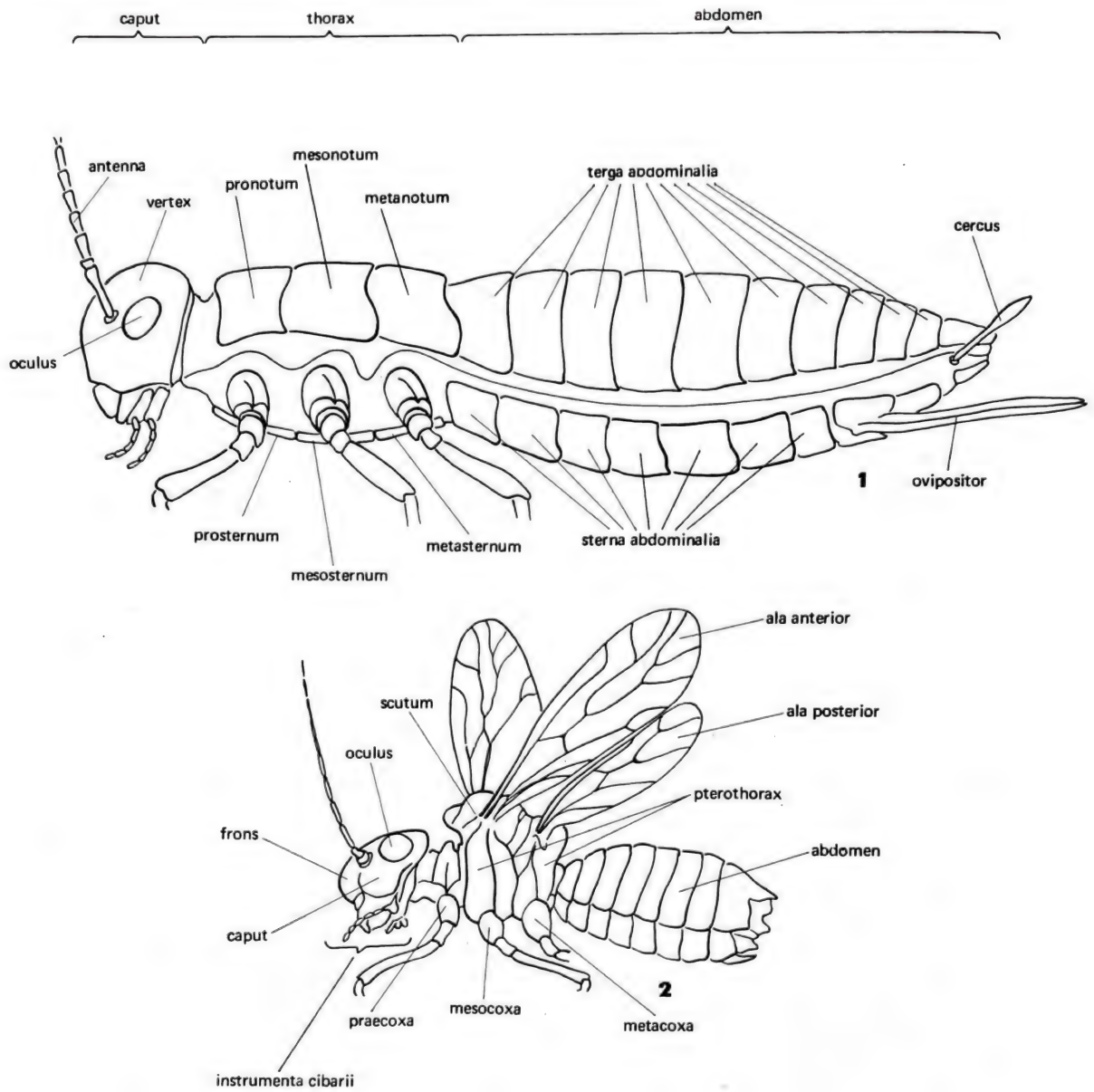
The figure captions are in English. Figures connected with one another in the caption are separated by a comma, parts not strictly related by a dash. In parentheses at the end of each figure caption the names of the authors of the respective source books are given in alphabetical order. The major part of the material is to be found in various anatomical and morphological works in the world literature. In the case of a general figure of mere reference value, it is not a practice to give the relevant source, thus, the original work of some of the drawings is today well-nigh impossible to trace and has little significance anyway. Following this principle those figures which are the result of the present authors' original research are similarly not marked by the word "original" or otherwise.

After the atlas part the two indexes are appended: a Latin—English and an English—Latin. Perhaps a few words are not wholly out of place here concerning this section of the book. First, it would be far more precise to say Latin/Greek—English and English—Latin/Greek indexes, since in numerous instances the literature uses Greek words and in even greater number words of Greek derivations. Secondly, it is frequently possible to find in the literature words with a correct Latin ending, e.g. *pleura*, which in fact is the plural form of the original Greek *pleuron*; but some authors take the word to be a singular Latin noun and suffix the Latin plural ending *-e* for the feminine noun obtaining "pleurae" (used in human anatomy) wishing to determine the two lateral regions of what is generally a thoracic segment of the insect body. Even though it is far beyond the

scope of the present work to clarify linguistically all the problematic derivations, to enhance utility coupled with accuracy the applied terms have been carefully selected and linguistically checked. Thirdly, in the case when the original Greek as well as its Latinized version are also used, we were inclined to employ the more commonly used form, as mentioned earlier. Thus, we simply compiled an index of the words figuring in the plates, complementing these with some of their more important synonyms; we did this in order to provide a tool at its most appropriate place.

The indexes are arranged in an absolute alphabetical order, and the words are given as they appear in the plates. Words are given in their correct orthographical form except in some rare instances when a form although objectionable has attained such wide recognition in world literature that the correct form would appear out of place, an example of this is *coxopodite* for *coxapodite*. In the case of adjectival structures the Latin—English part presented no problem since the nouns, e.g. *clavus*, *fossa*, *sutura*, etc. are always at the beginning of the expression, which does not hold, of course, for the English—Latin part. Just the same, there too the present authors followed strict alphabetical order. After the word-pairs the numbers refer to the respective figures.

PLATES



Figs. 1—2. Schematic drawing of the insect in lateral view. — 1: Wingless, and 2: winged (after Kéler 1, and Weber 2)

THE HEAD

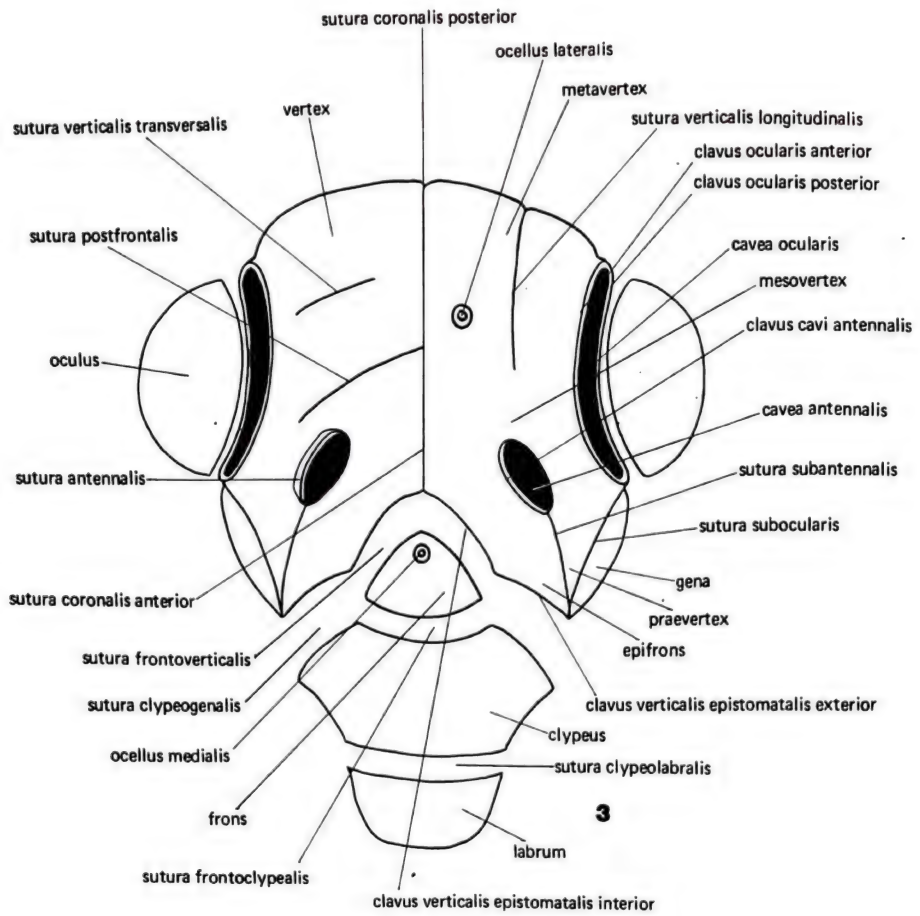
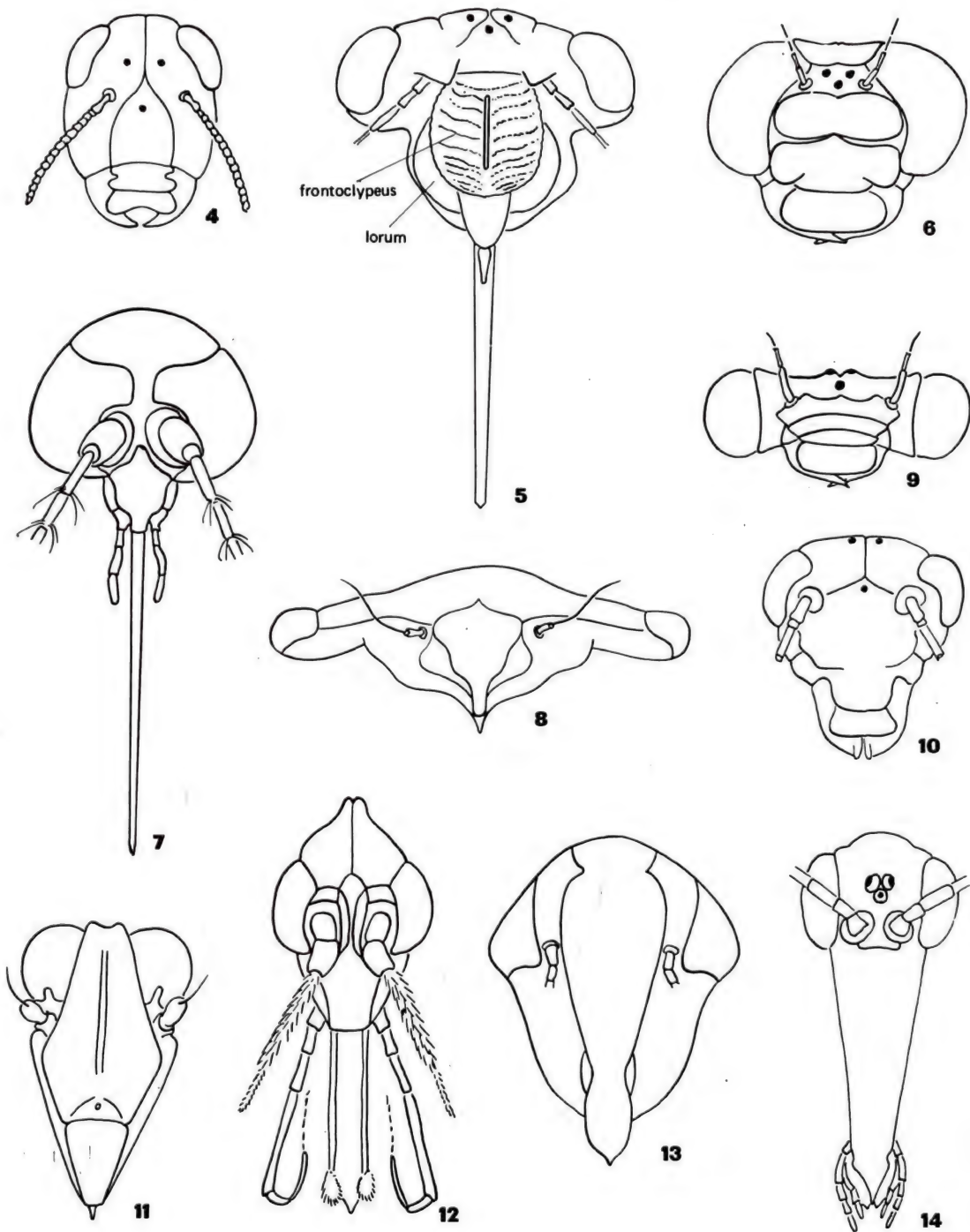


Fig. 3. Schematic drawing of the insect head in frontal view



Figs. 4–14. Principal types of the insect head in frontal view. — 4: *Schistocerca* (Orthopt.), 5: *Magicicada* (Homopt.), 6: Anisoptera (Odon.) 7: *Culicoides* (Dipt.), 8: Membracidae (Homopt.), 9: Zygoptera (Odon.), 10: Hymenoptera, 11: Fulgoridae (Homopt.), 12: Psychodidae (Dipt.), 13: Heteroptera, and 14: *Panorpa* (Mecopt.) (after Shvanvich 5, 12, Snodgrass 4, 8, 10, 11, 13)

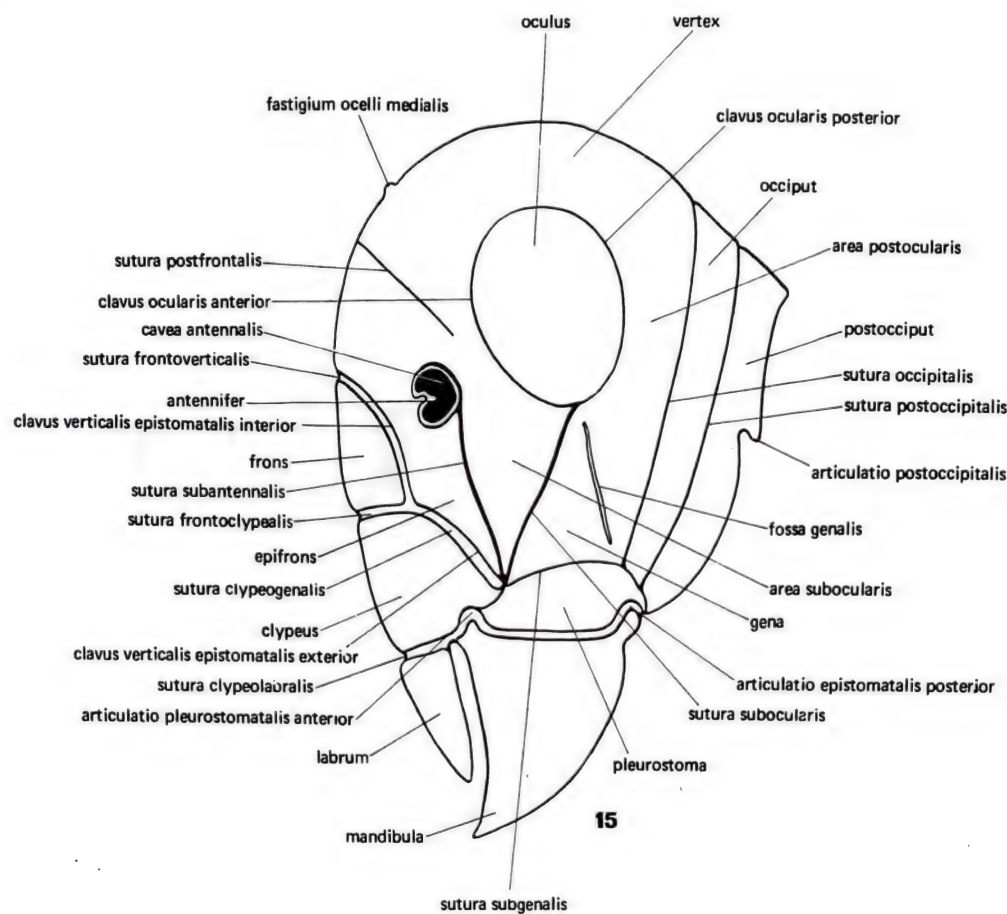
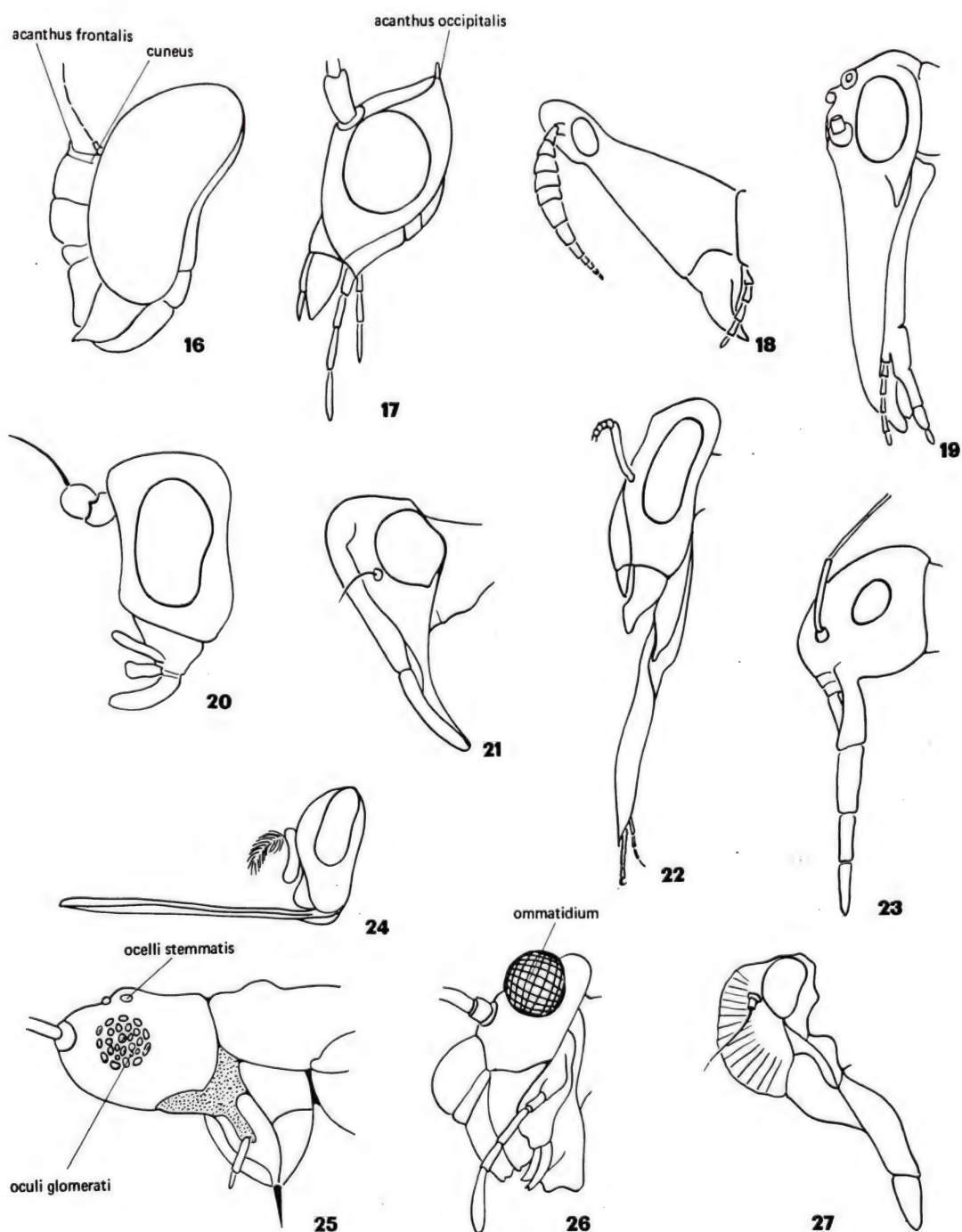


Fig. 15. Schematic drawing of the insect head in lateral view



Figs. 16–27. Principal types of the insect head in lateral view. — 16: *Sympetrum* (Odon.), 17: *Wesmaelius* (Neuropt.), 18: *Acrida* (Orthopt.), 19: *Panorpa* (Mecopt.), 20: Diptera, 21: Homoptera, 22: *Apis* (Hymenopt.), 23: Heteroptera, 24: *Culicoides* (Dipt.), 25: Thrips (Tysanopt.), 26: *Psocus* (Psocopt.), and 27: *Magicicada* (Homopt.) (after Shvanvich 21, 22, 25, Snodgrass 20, 24, 26, 27)

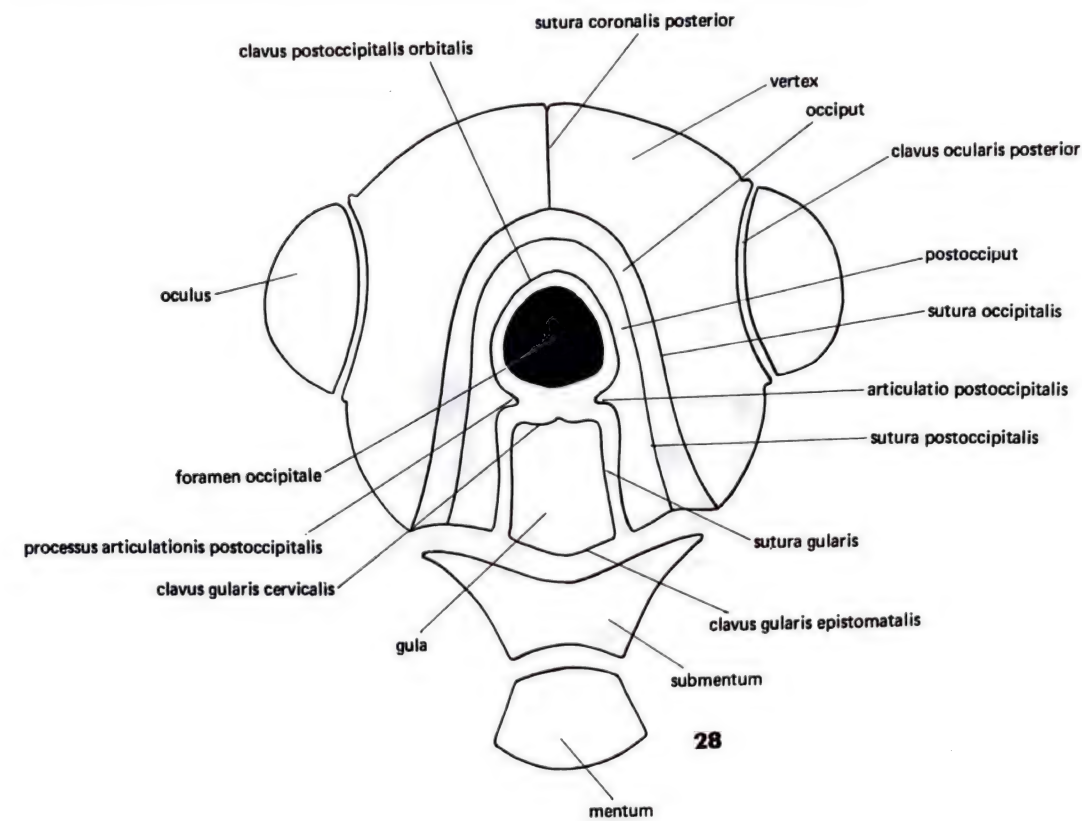
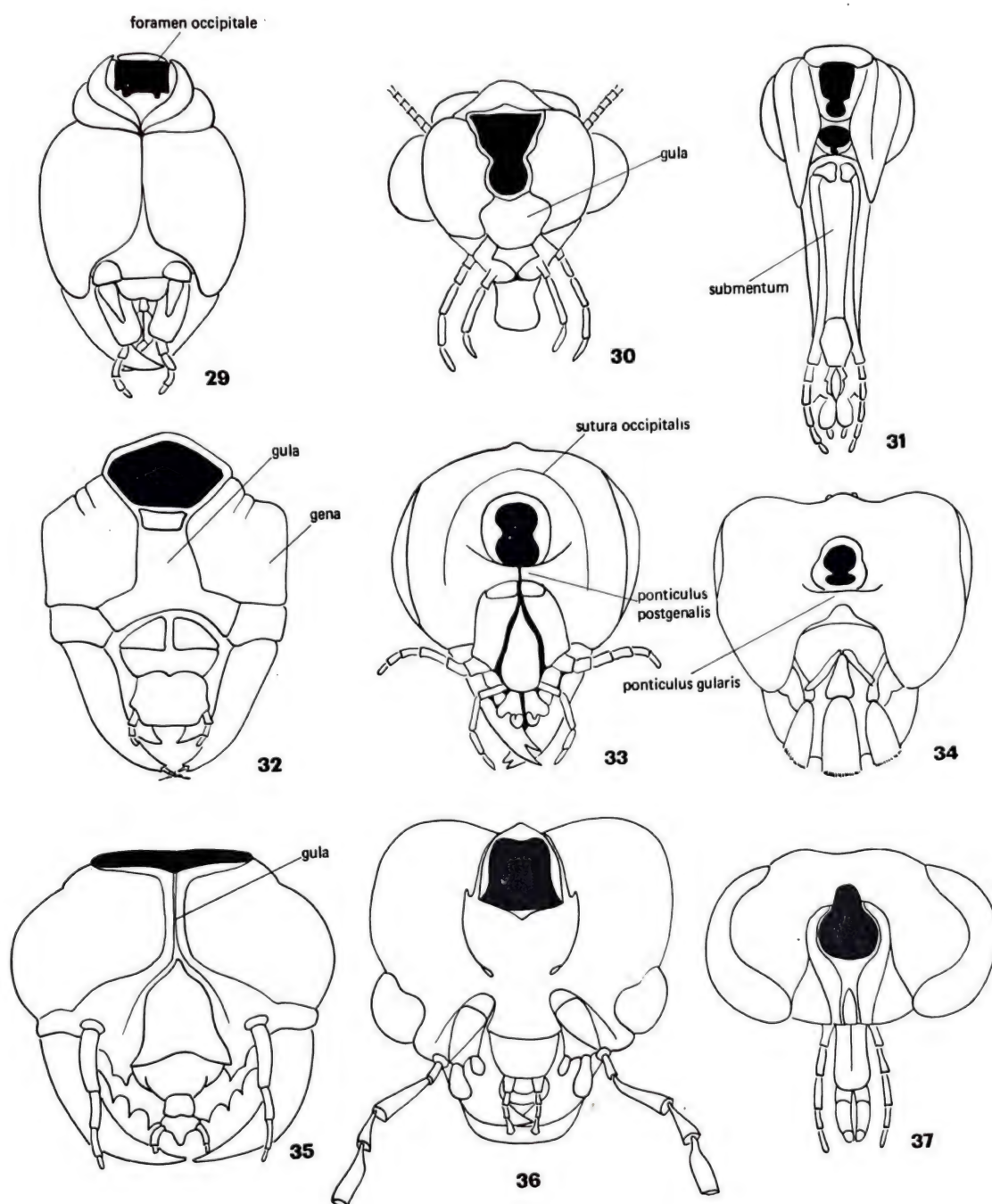
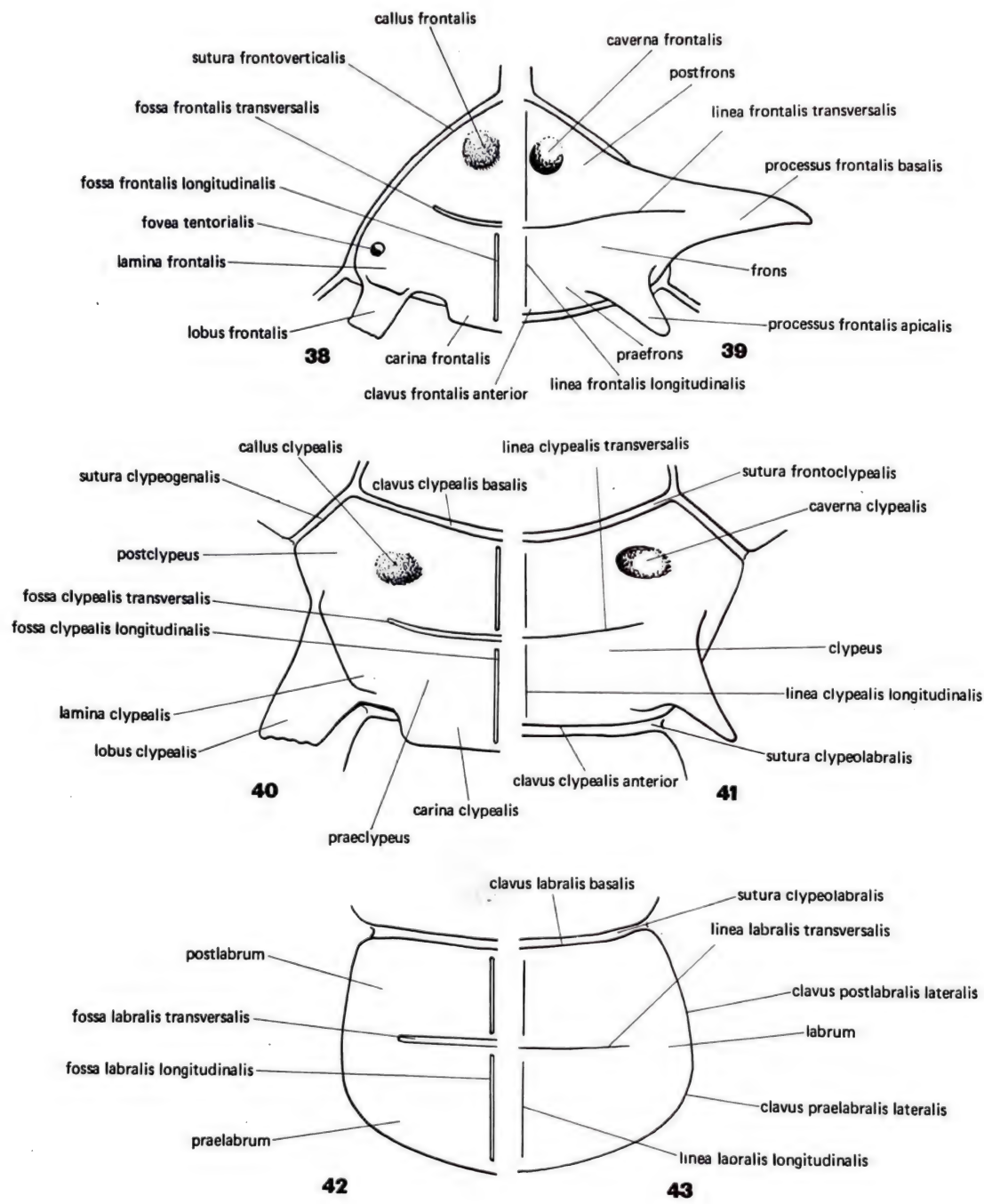


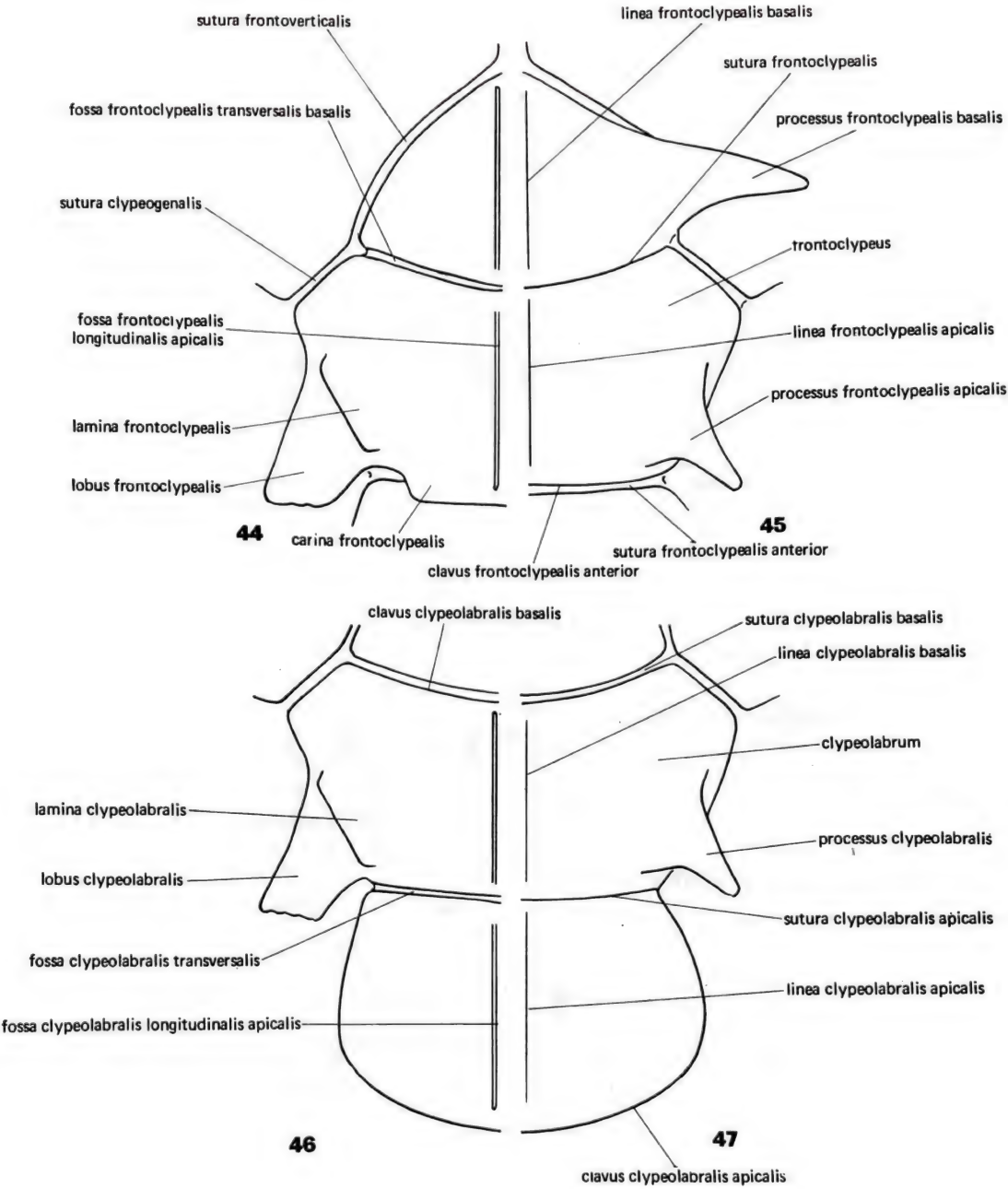
Fig. 28. Schematic drawing of the insect head in posterior view



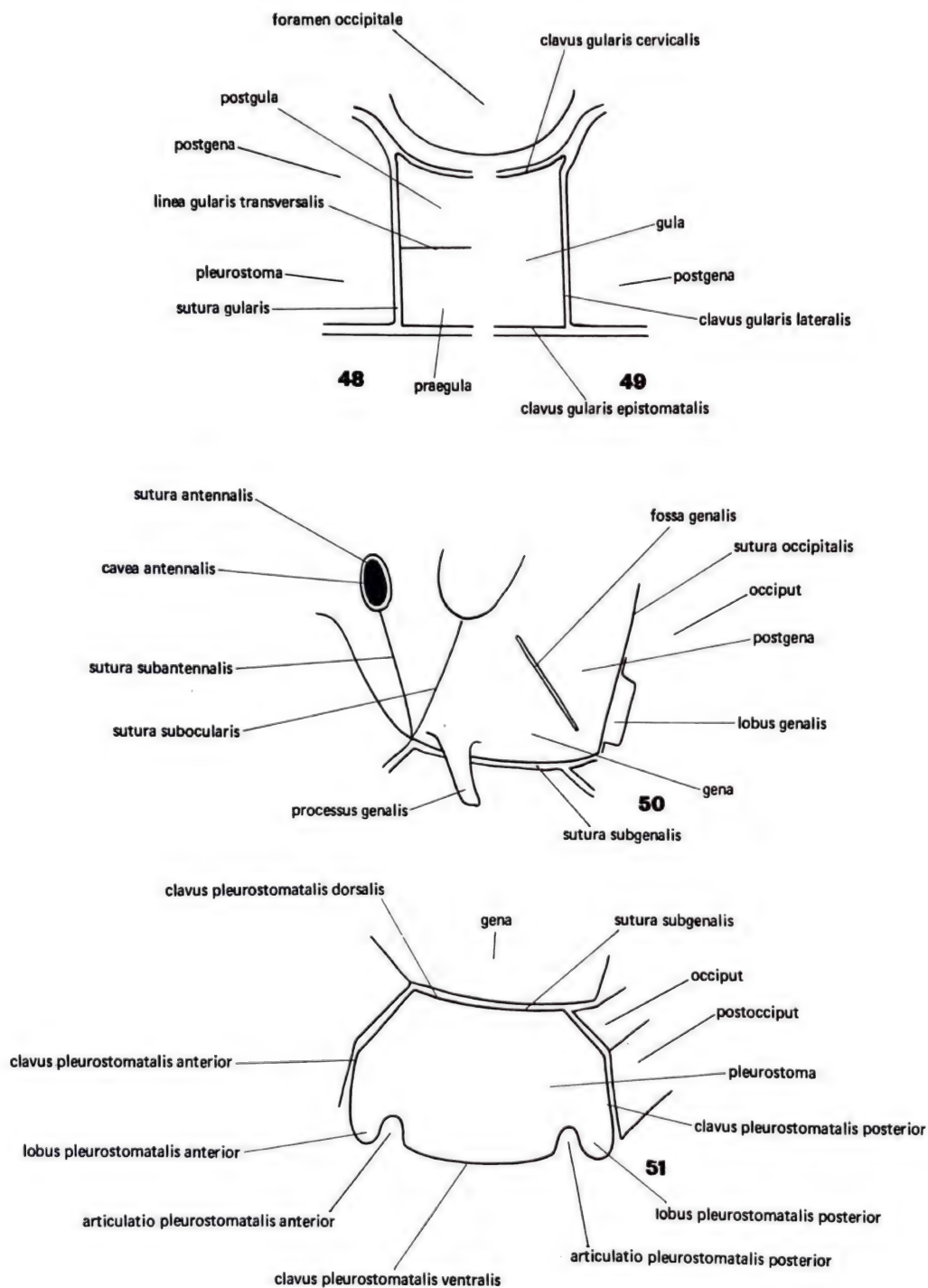
Figs. 29–37. Principal types of the insect head in posterior view. — 29: *Staphylinus* (Coleopt.), 30: *Myrmeleon* (Neuropt.), 31: *Panorpa* (Mecopt.), 32: *Sialis* (Megalopt.), 33: *Vespa* (Hymenopt.), 34: *Apis* (Hymenopt.), 35: *Thinopinus* (Coleopt.), 36: *Melandrya* (Coleopt.), and 37: *Culicoides* (Dipt.) (after Shvanvich 33, and Snodgrass 29, 32, 34–37)



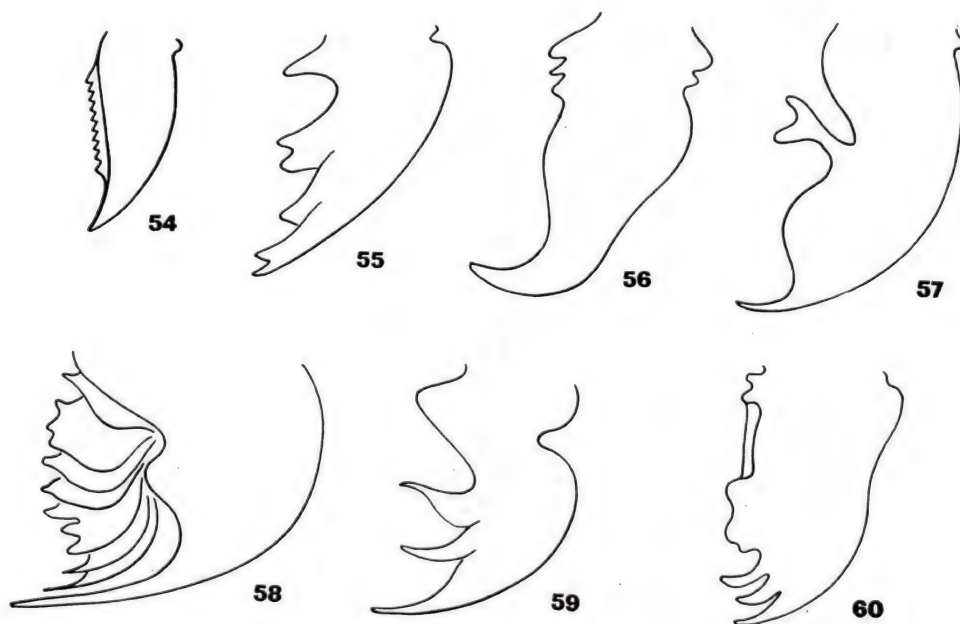
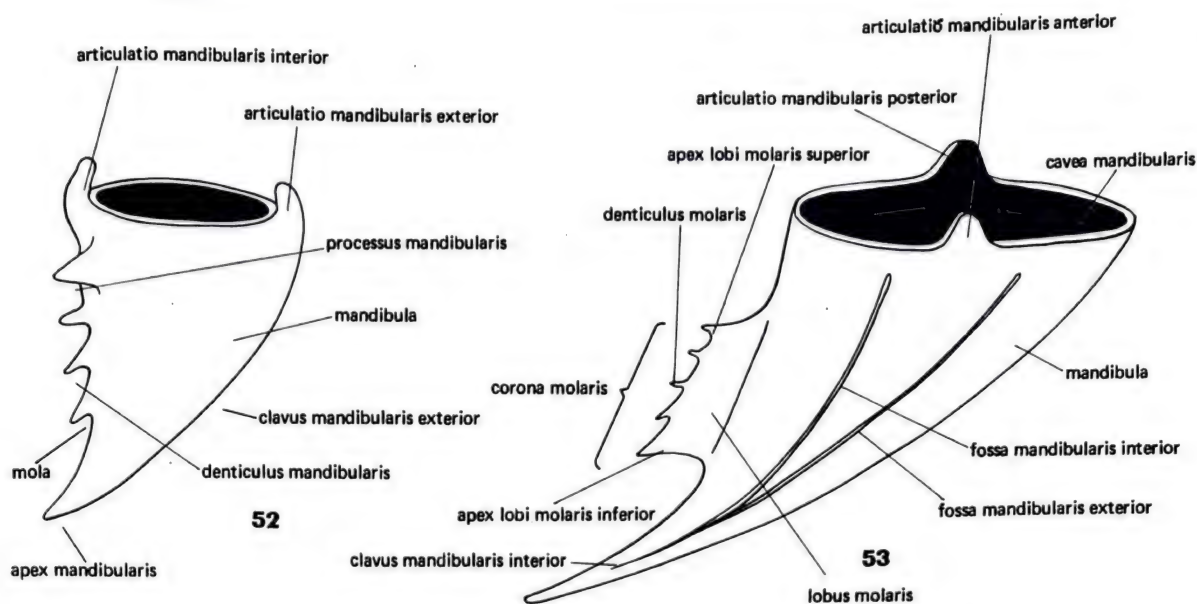
Figs. 38–43. Schematic drawing of 38–39: the frons, 40–41: the clypeus, and 42–43: the labrum



Figs. 44–47. Schematic drawing of 44–45: the frontoclypeus, and 46–47: the clypeolabrum



Figs. 48–51. Schematic drawing of 48–49: the gula, 50: the gena, and 51: the pleurostoma



Figs. 52–60. The mandible (mandibula). — 52–53: The two main types of mandibular articulation. 54–60: Principal types of the mandible, 54: *Heliocopris* (Coleopt.), 55–56: Orthoptera, 57: *Anax* (Odon.), 58: *Acrydium* (Orthopt.), 59: *Hydrous* (Coleopt.), and 60: *Periplaneta* (Blatt.) (after Shvanvich 54–60)

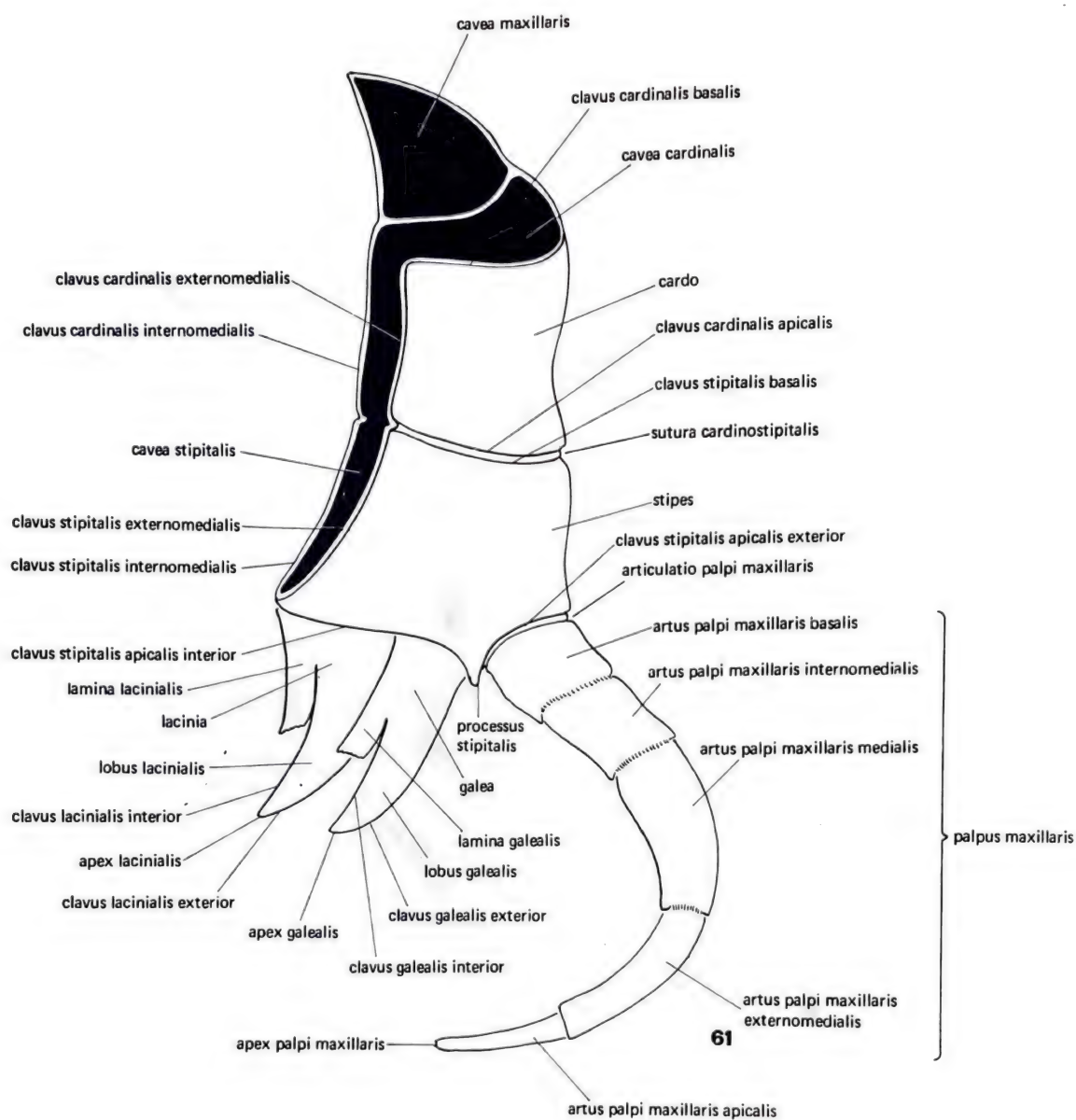
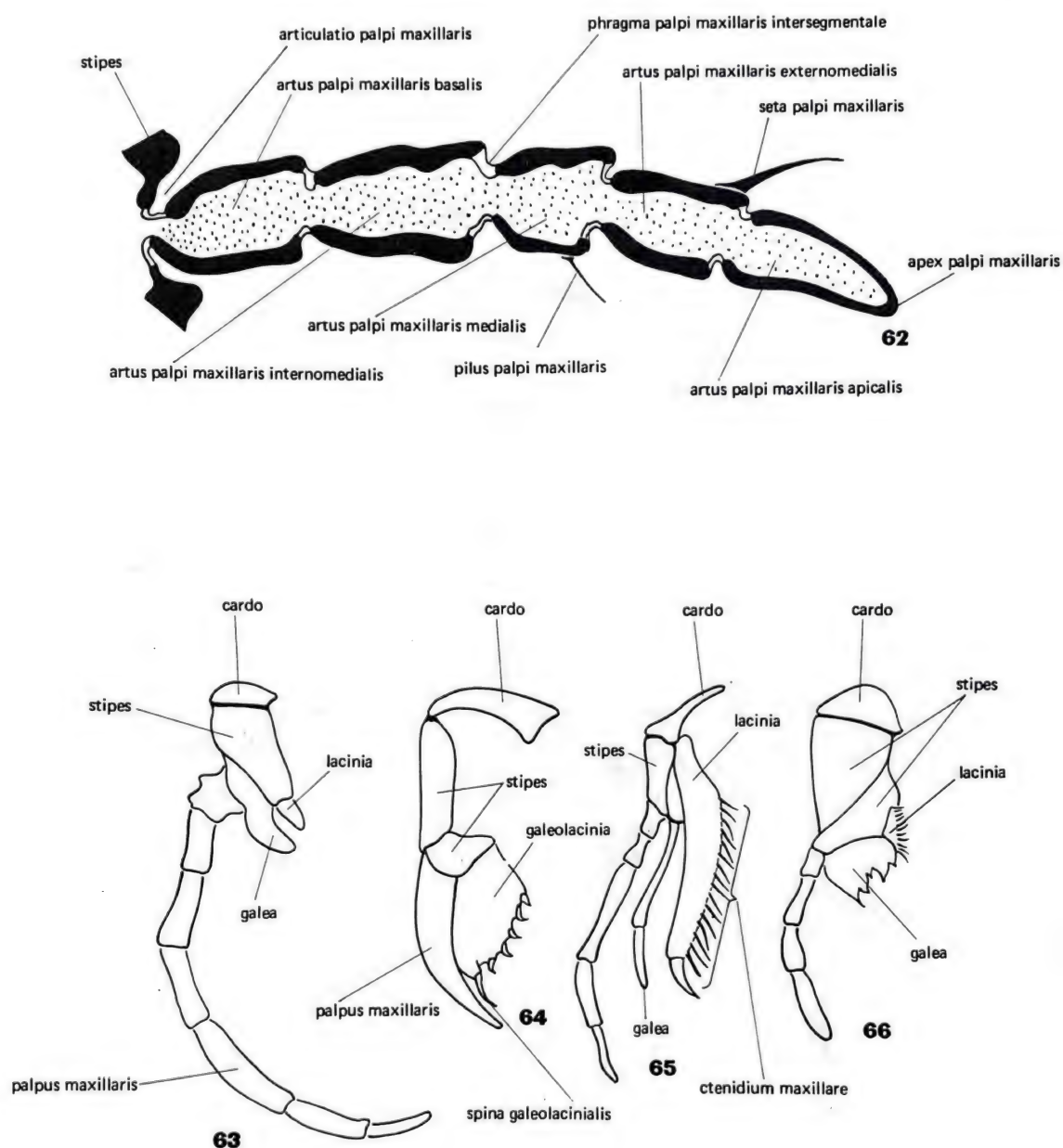
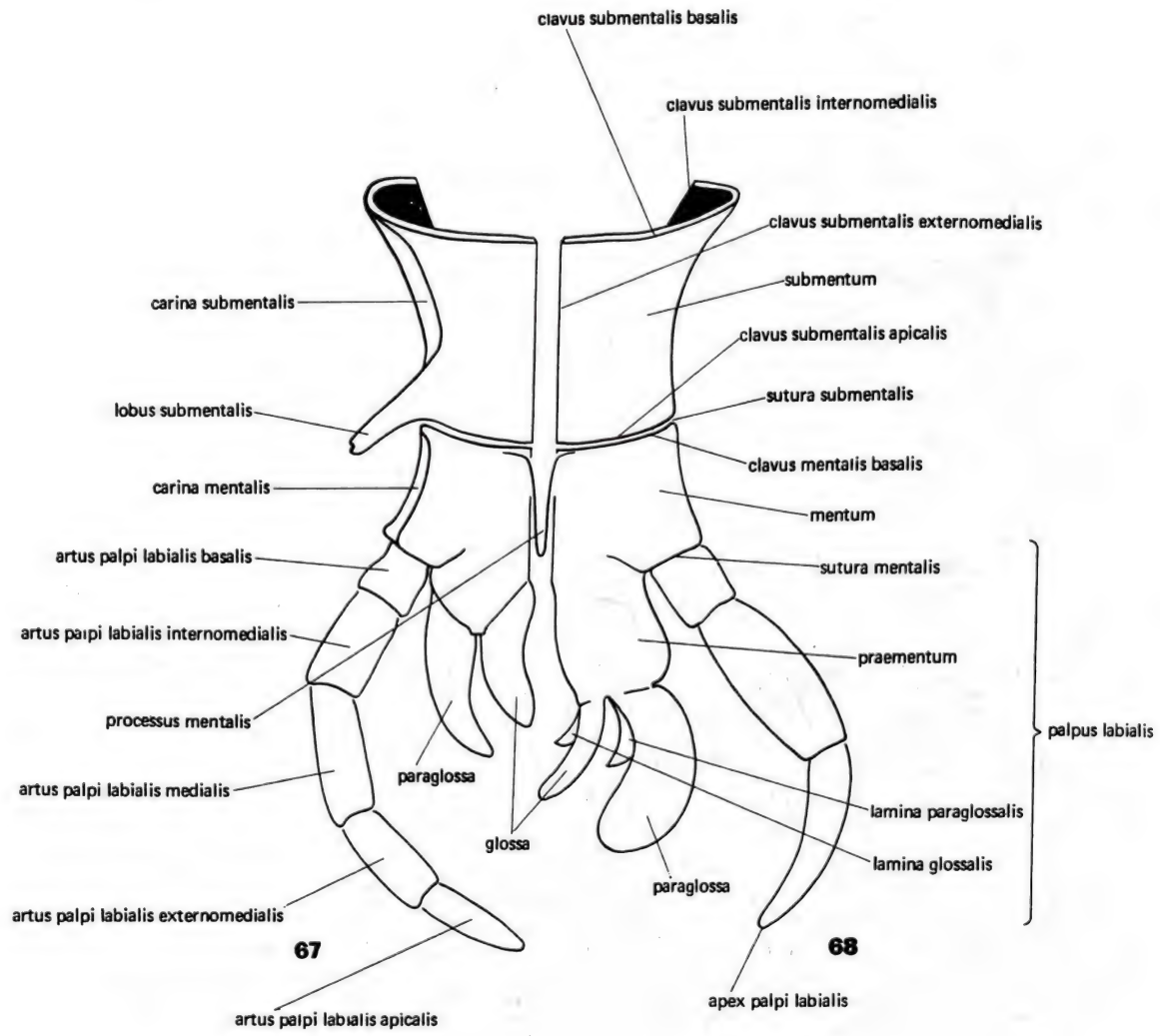


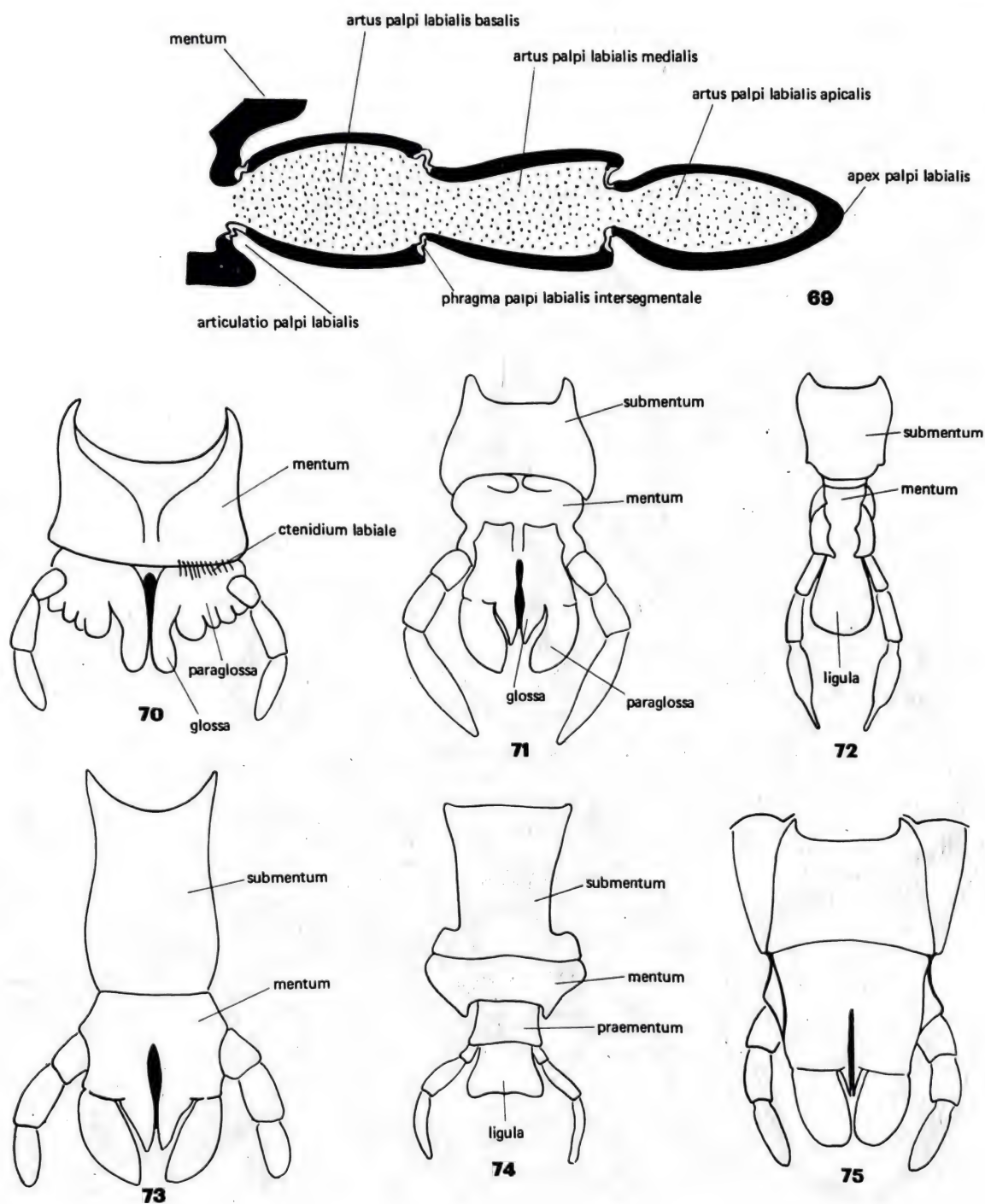
Fig. 61. The maxilla



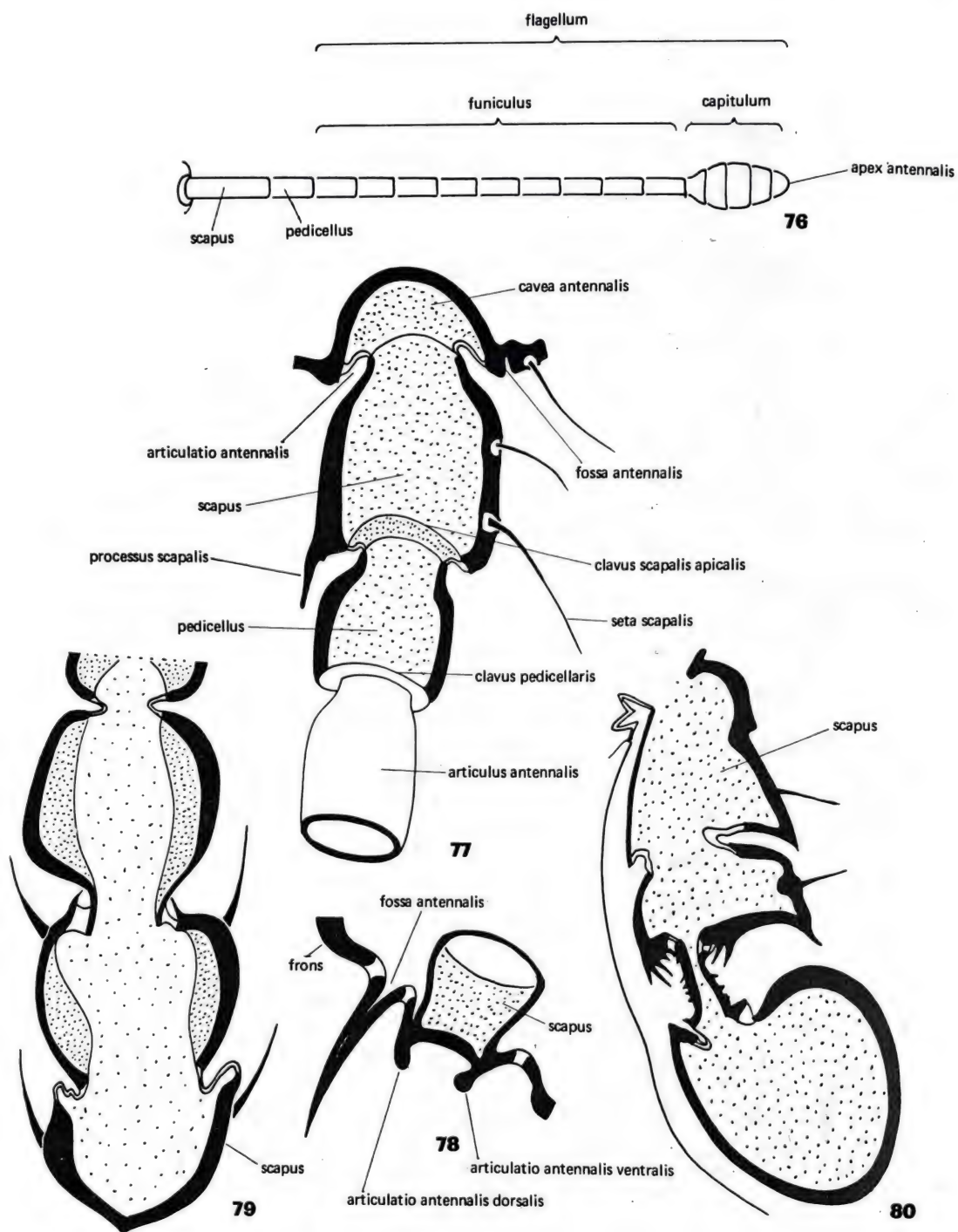
Figs. 62–66. The maxillary palp (palpus maxillaris) and the principal types of the maxilla. — 62: The maxillary palp, 63: *Machilis* (Diplura), 64: *Aeshna* (Odon.), 65: *Cicindella* (Coleopt.), and 66: *Melolontha* (Coleopt.) (after Wenk 62, and Weber 63–66)



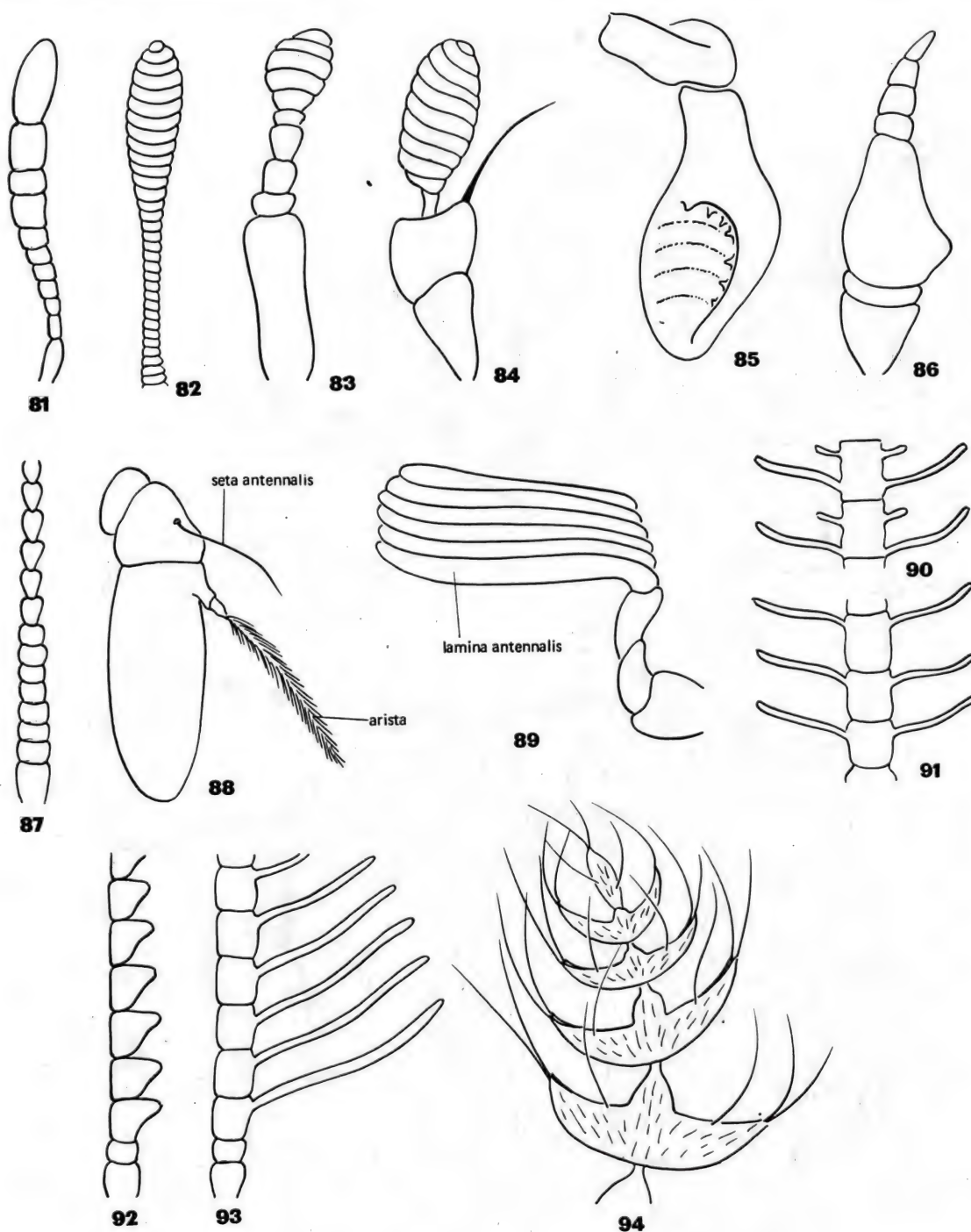
Figs. 67–68. The labium. — 67: Schematic drawing of a five-jointed, and 68: a three-jointed palp



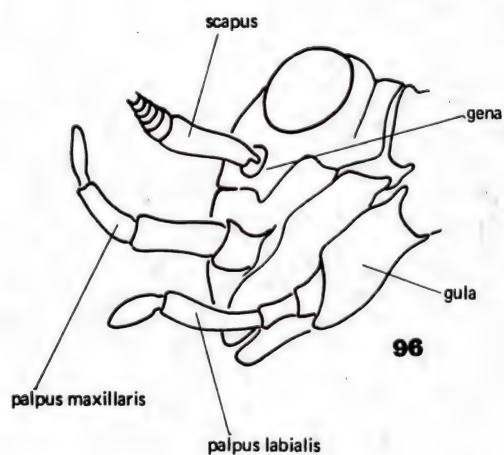
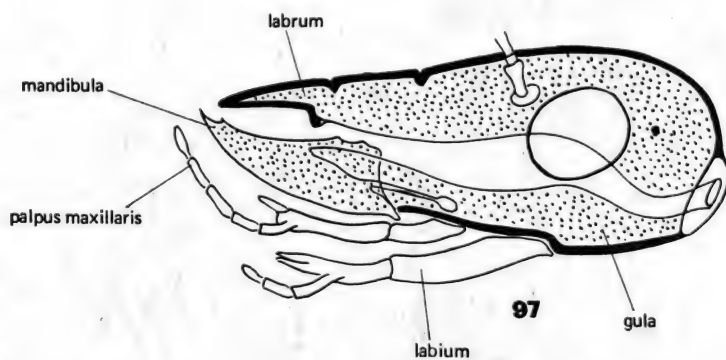
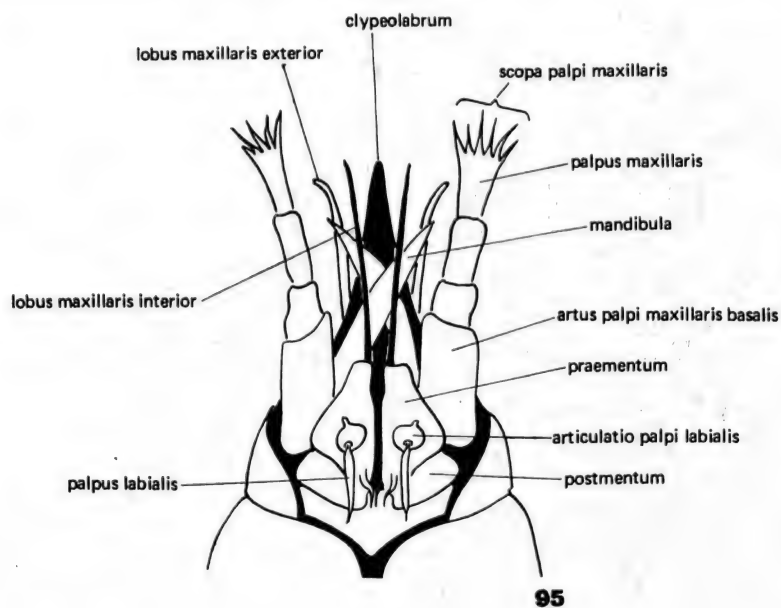
Figs. 69–75. The labial palp (palpus labialis) and the principal types of the labium. — 69: The labial palp, 70: *Machilis* (Diplura), 71: *Periplaneta* (Blatt.), 72: *Wesmaelius* (Neuropt.), 73: *Termopsis* (Isopt.), 74: Coleoptera, and 75: Embioptera (after Shvanvich)



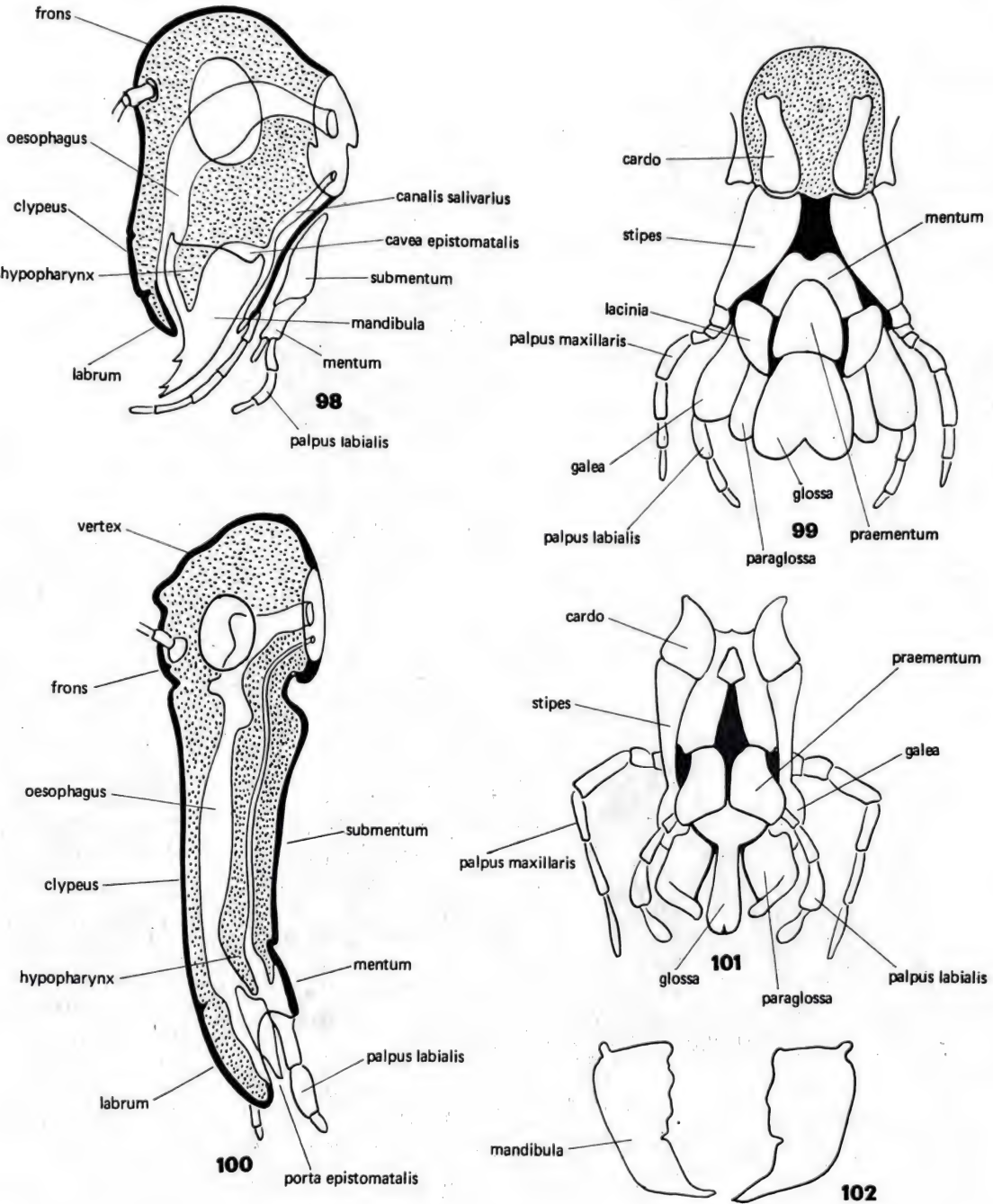
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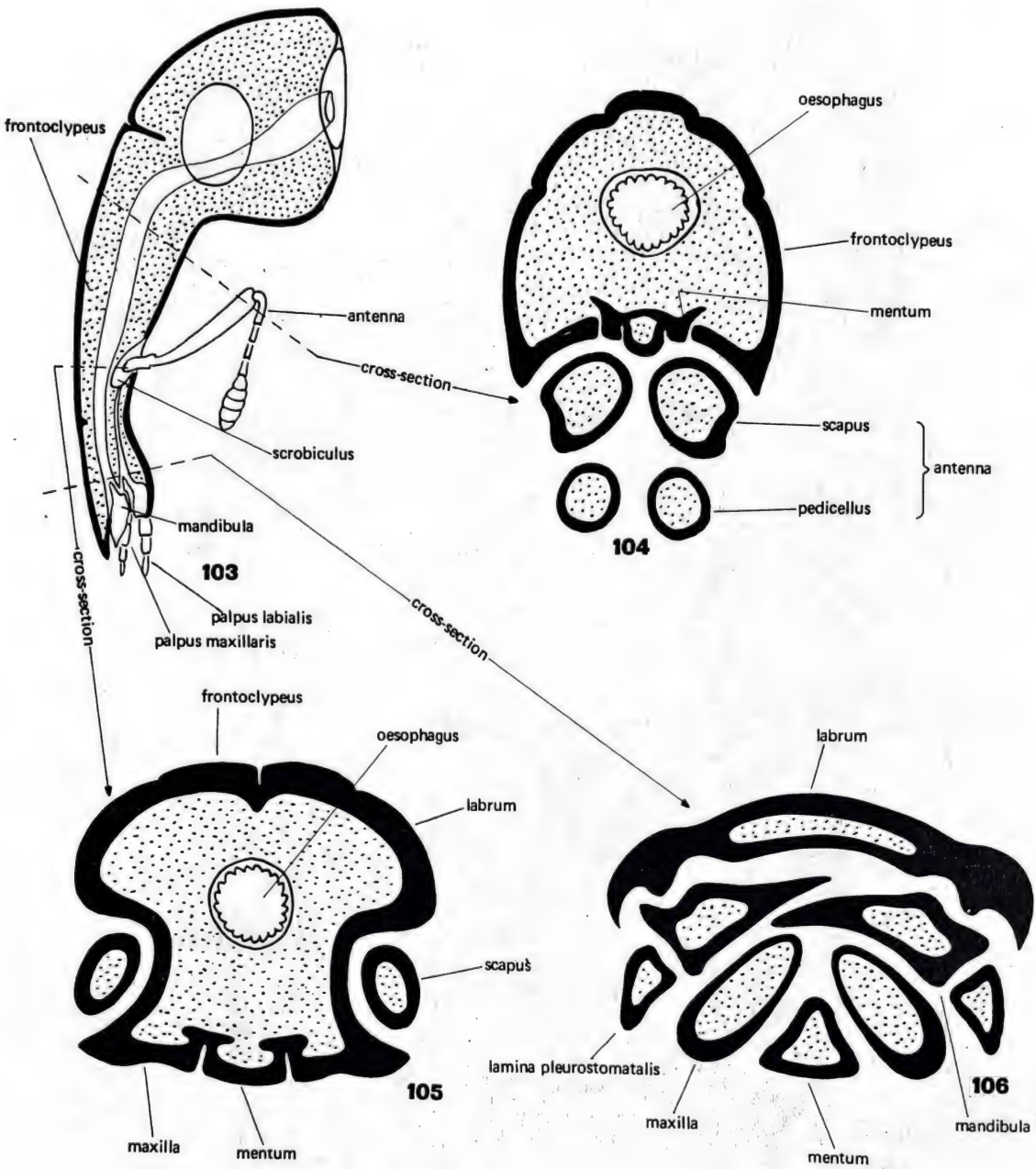
Figs. 81–94. Characteristic types of the antenna. — 81: Abbreviate antenna (*antenna abbreviata*). 82: incrassate (*a. incrassata*), 83: clavate (*a. clavata*), 84: spathulate (*a. spathulata*), 85: laminate (*a. laminata*), 86: mucronate (*a. mucronata*), 87: attenuate (*a. attenuata*), 88: setigerous (*a. setigera*), 89: lamellate (*a. lamellata*), 90: alternately pinnate (*a. inaequaliter pinnata*), 91: plumose (*a. plumata*), 92: imbricate (*a. imbricata*), 93: pectinate (*a. pectinata*), and 94: fusiform (*a. fusiformis*) (after Daday)



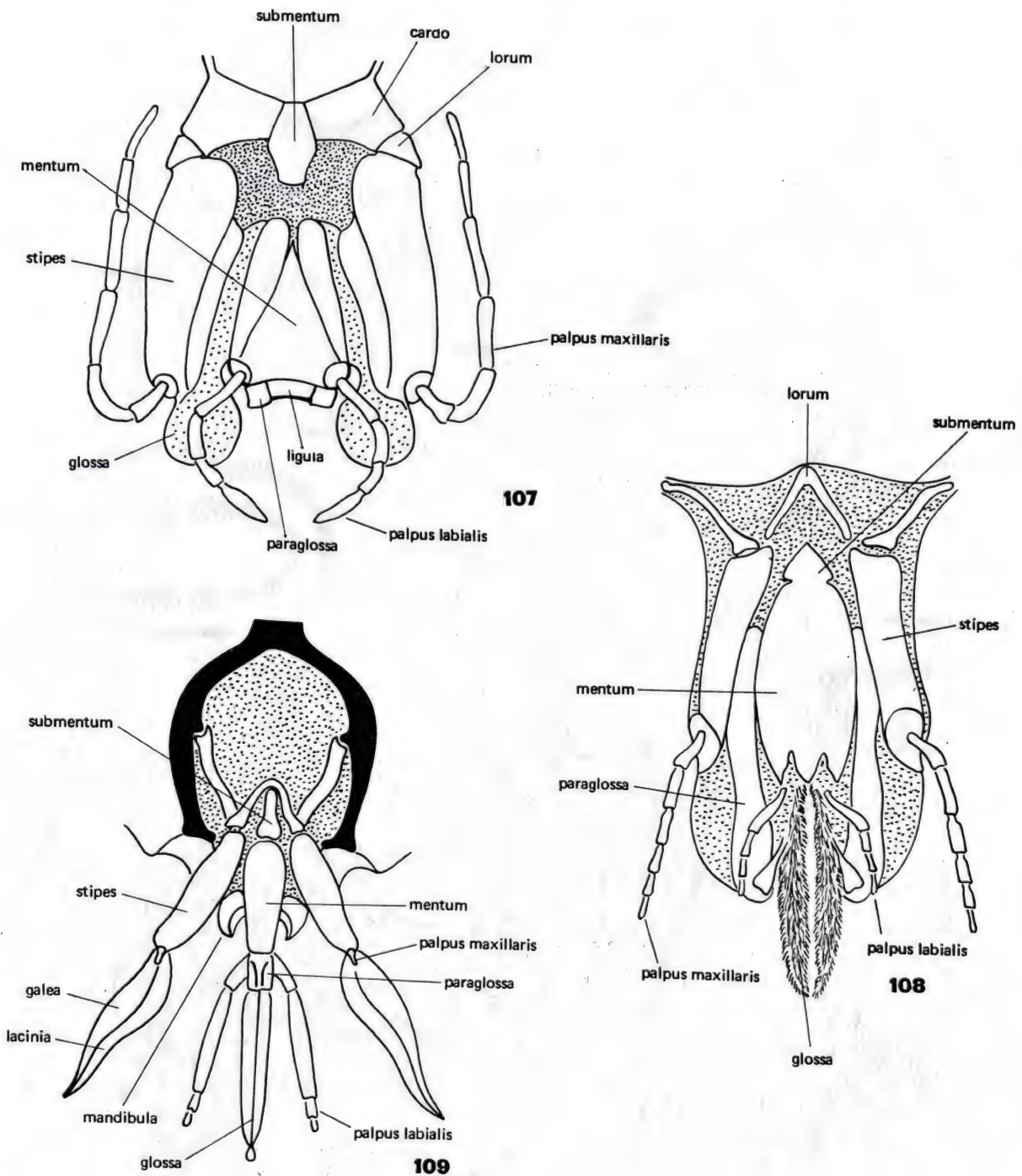
Figs. 95–97. Principal types of the insect head. — 95: Entognath, 96: hypognath, and 97: prognath (after Matsuda 95, Shvanvich 96, Steinmann 97)



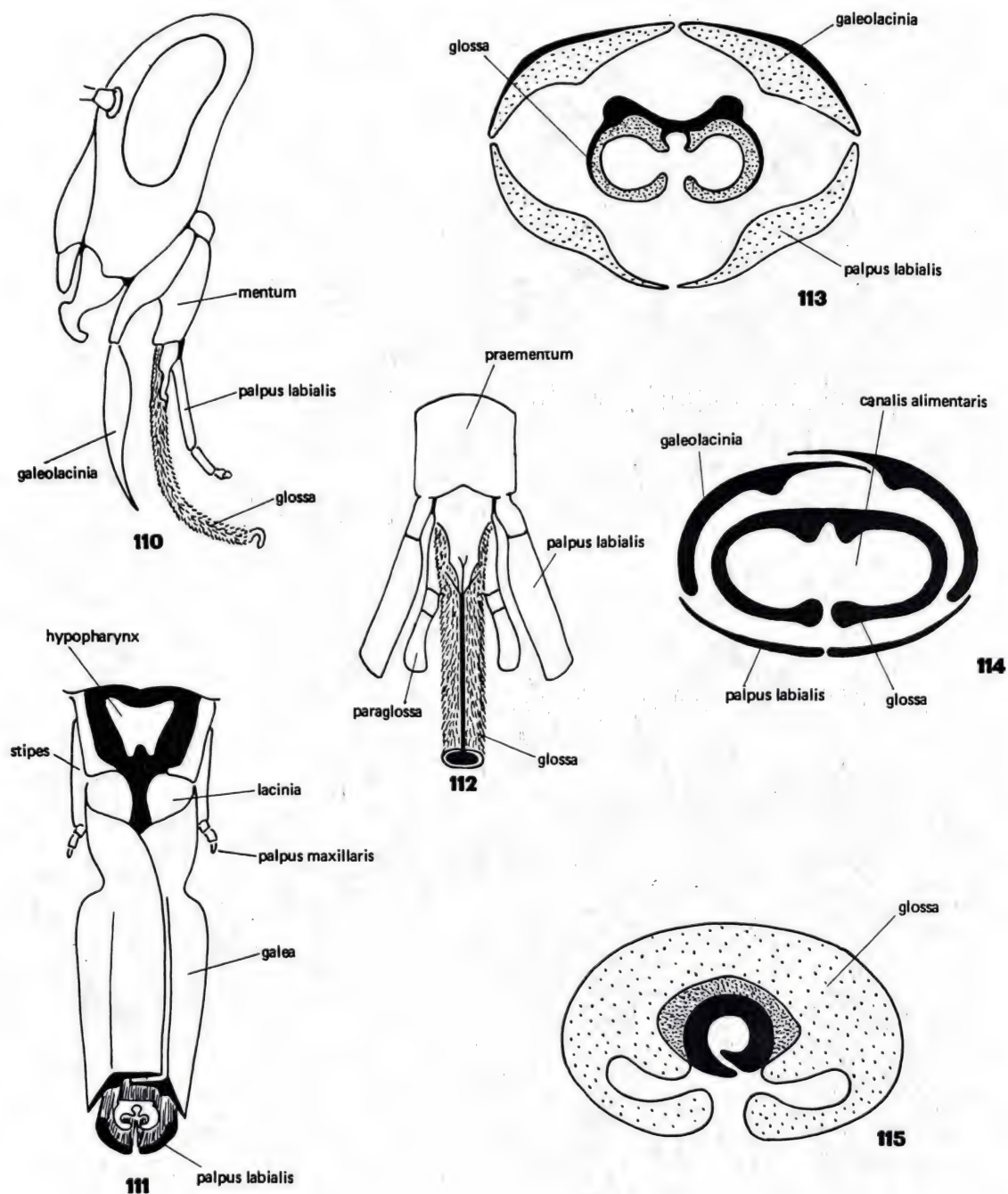
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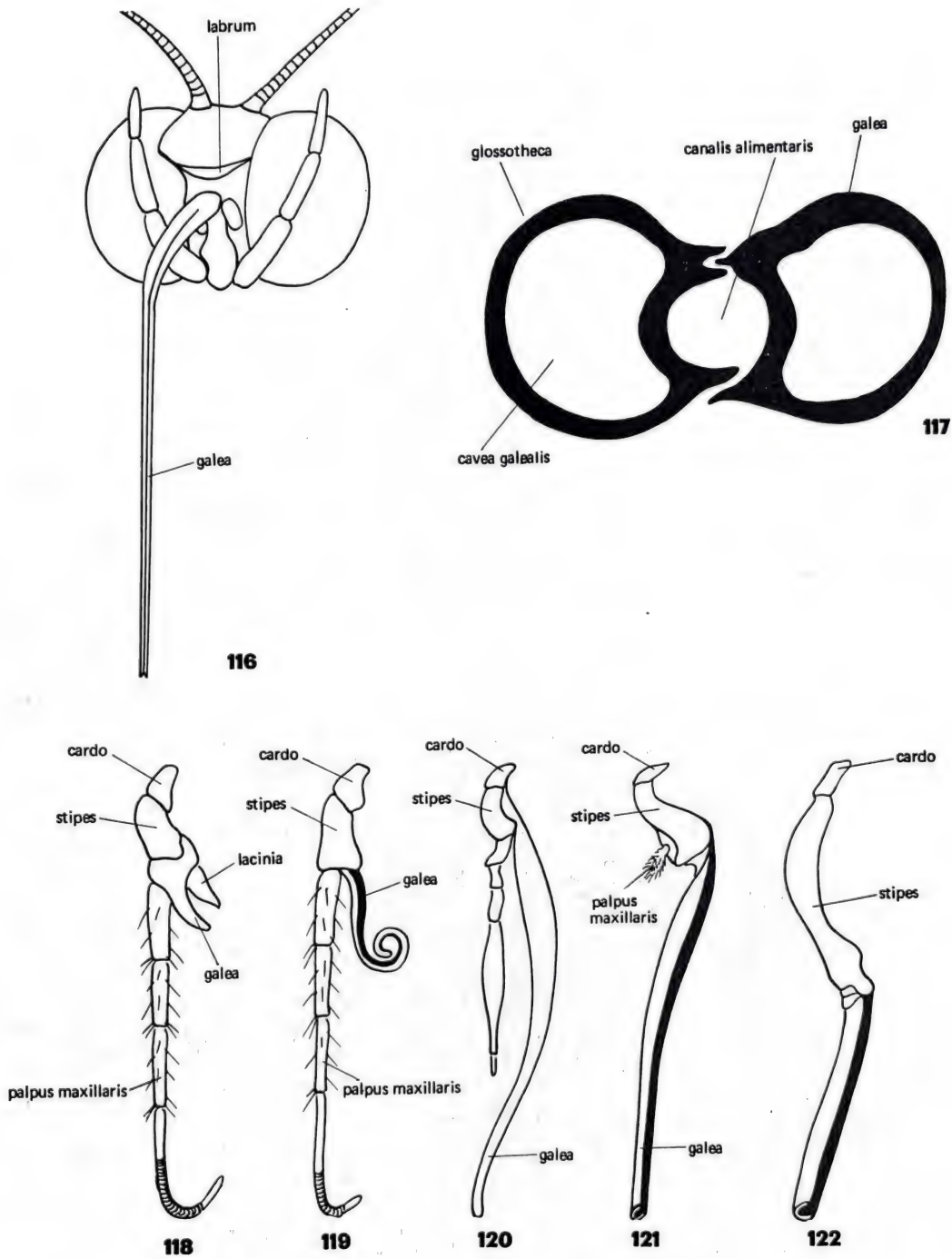
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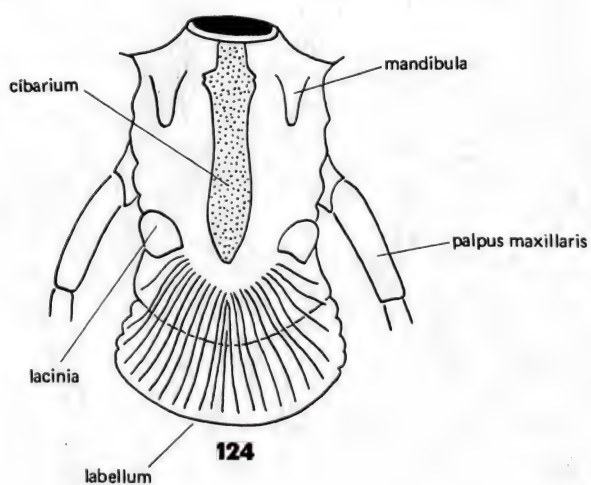
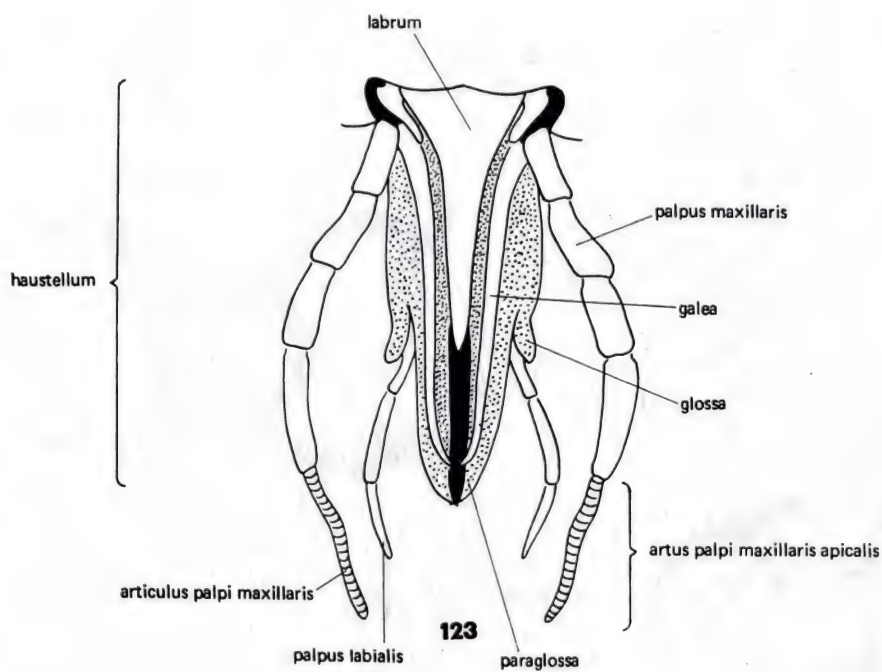
Figs. 107–109. Three types of mouthparts of Hymenoptera. — 107: Biting mouthparts of the Sphecidae-type, 108: transitional form between the biting and licking mouthparts of the Andrena-type, and 109: normal licking mouthparts of the Apis-type (after Snodgrass)



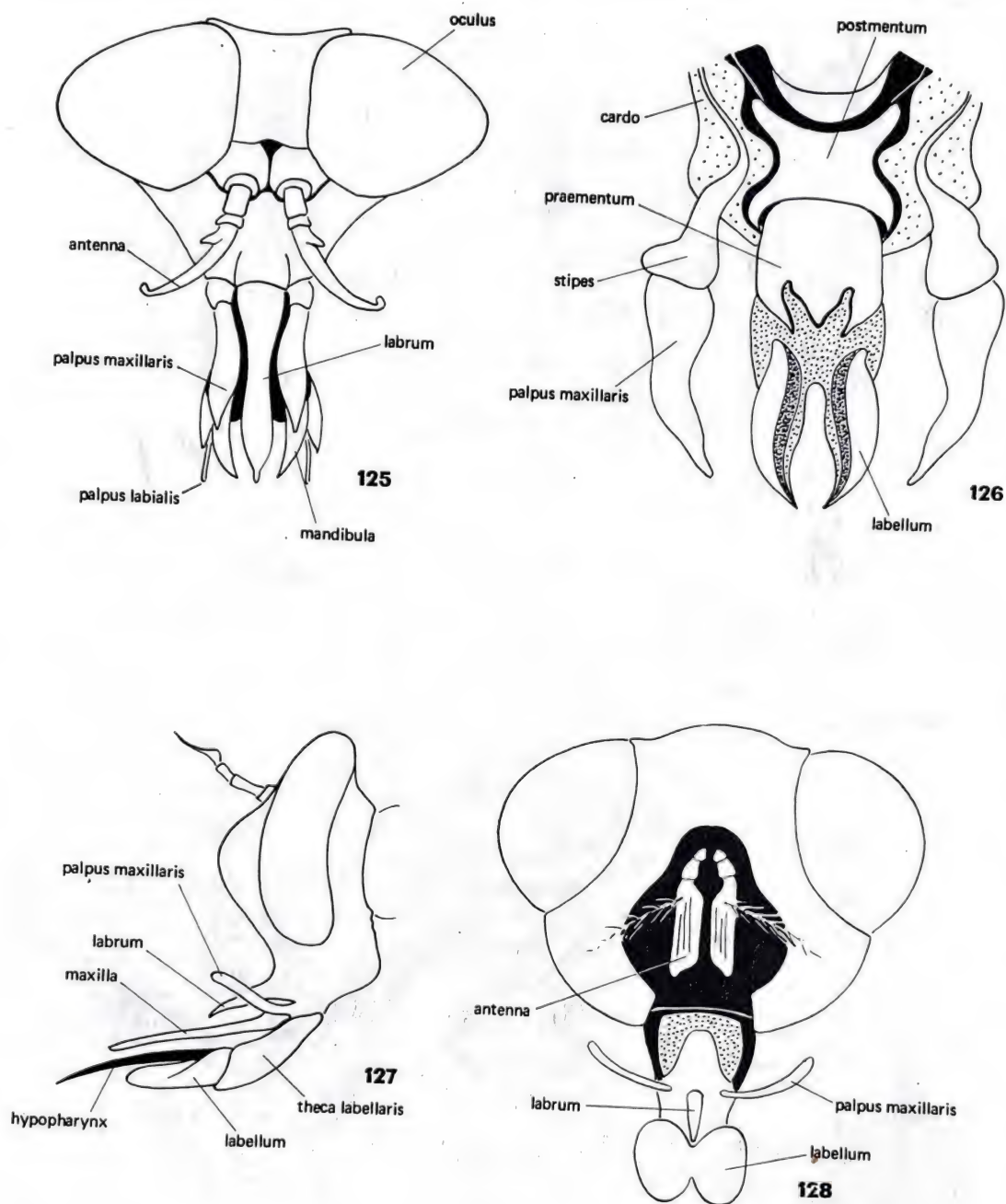
Figs. 110–115. Mouthparts of the licking type. — 110: Head of *Apis* (Hymenopt.) in lateral view, 111: proboscis with galea, 112: modified glossa in lateral view, 113: Proboscis in basal cross-section, 114: schematic proboscis in cross-section, and 115: proboscis in apical cross-section (after Shvanvich 111–115)



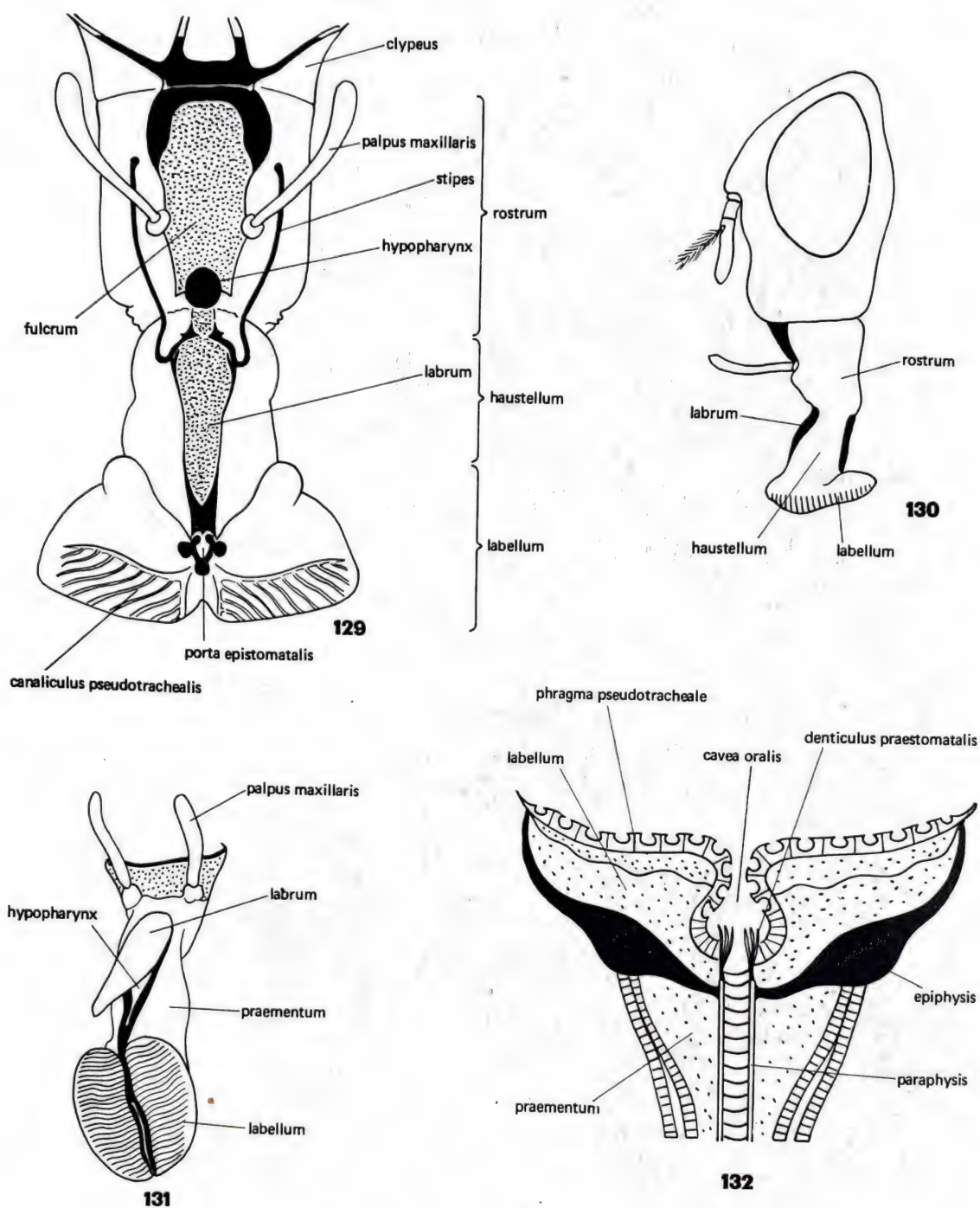
Figs. 116–122. Mouthparts of the sucking type of Lepidoptera. — 116: Head with coiled proboscis (*lingua spiralis*), 117: schematic proboscis in cross-section (*instrumenta suctoria*). 118–122: Modified galea, 118: *Micropteryx*-type, 119: *Mneomonica*-type, 120: *Pronuba*-type, 121: *Synanthedon*-type, and 122: *Sphinx*-type (after Burgess 117, and Shvanvich 118–122)



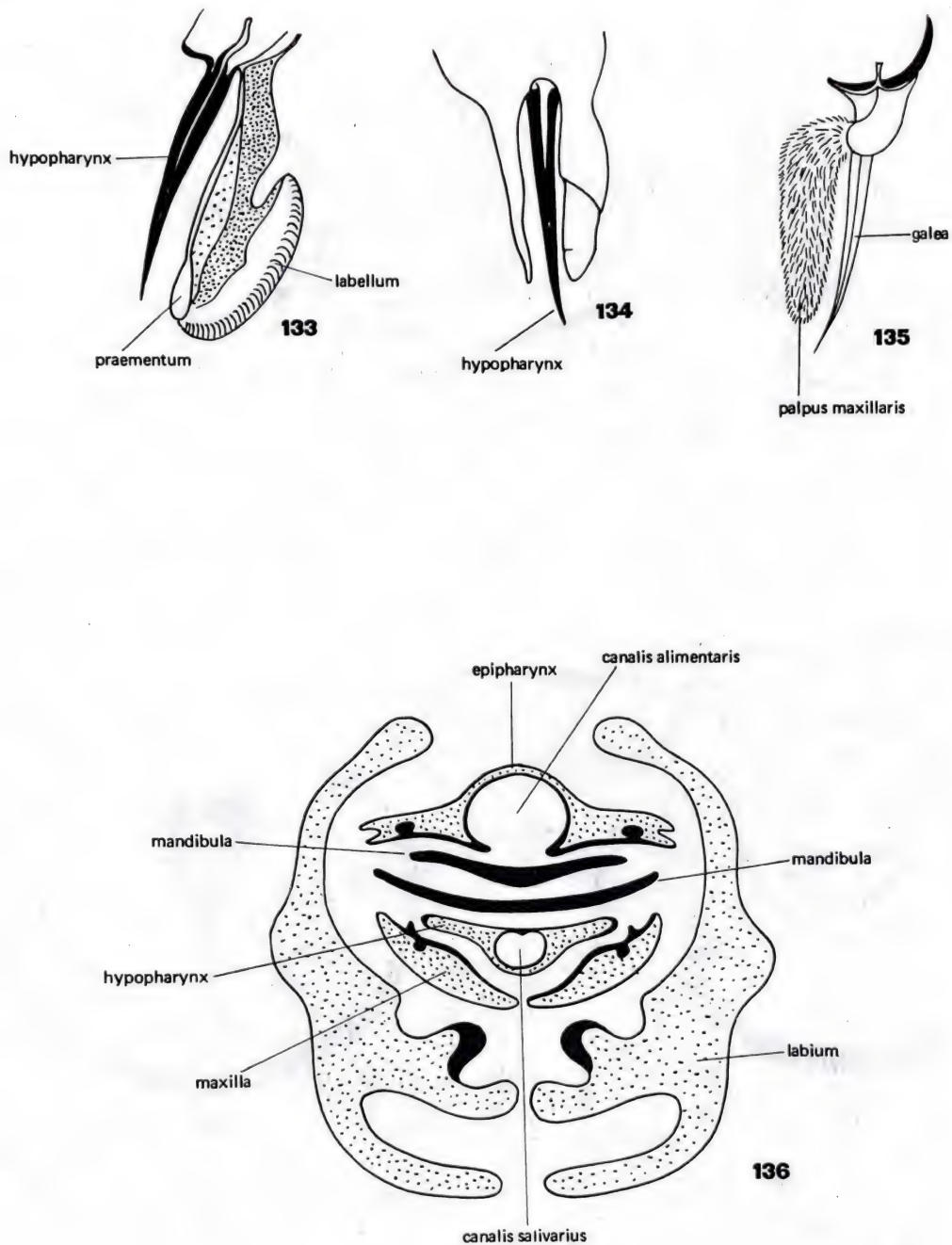
Figs. 123—124. Mouthparts of the sucking type of Trichoptera. — 123: Ventral aspect of proboscis of Phryganea-type, and 124: same in dorsal aspect (after Chrichton)



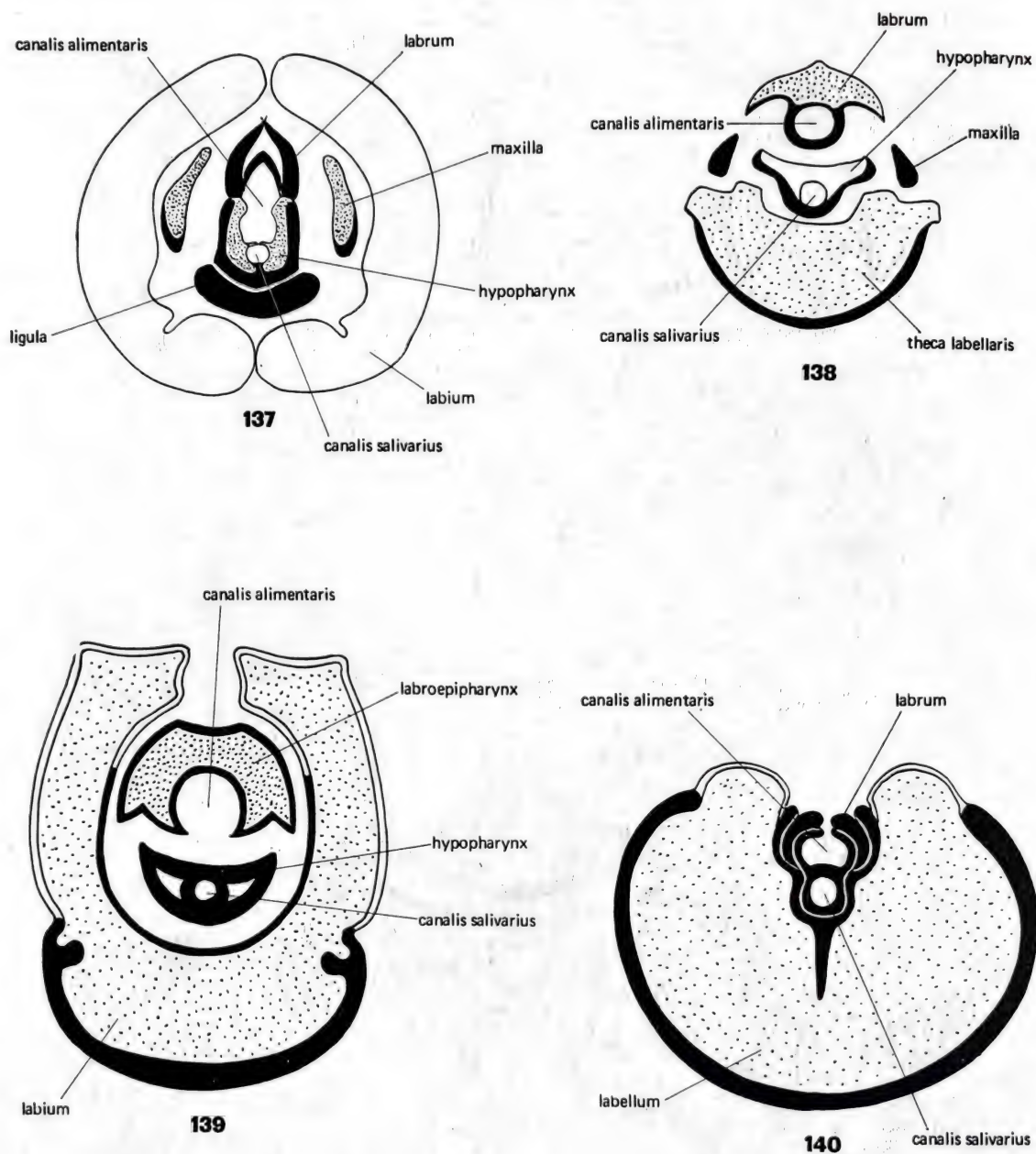
Figs. 125–128. Mouthparts of the piercing-sucking type with labellum. — 125: *Tabanus* head (Dipt.) in frontal view. 126: Mouthparts of the *Tabanus*-type in ventral view, 127: *Asilus* (Dipt.) head in lateral view, and 128: *Schizophora* (Dipt.) head in frontal view (after Snodgrass 125–126, Matsuda 127, and Shvanvich 128)



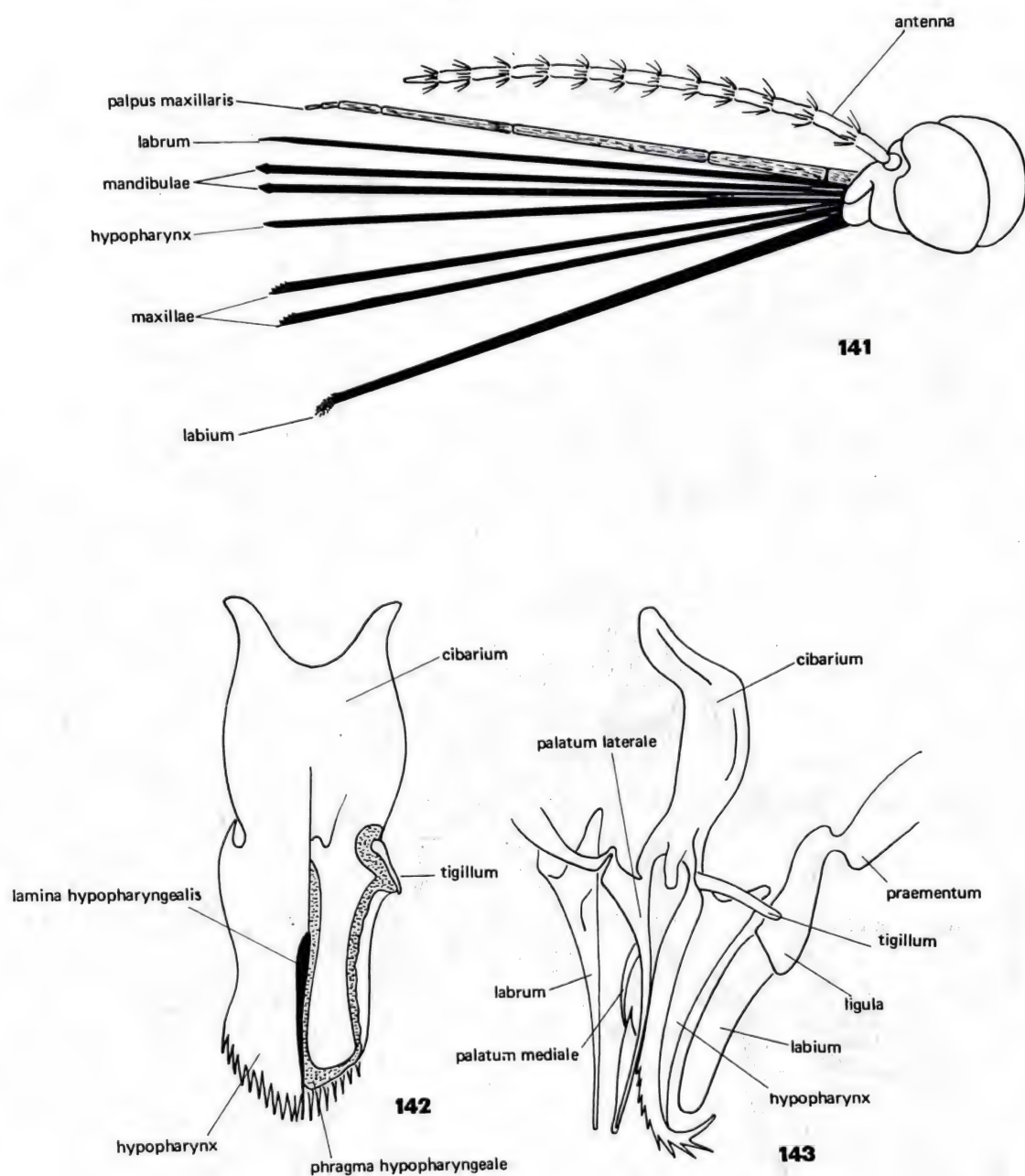
Figs. 129–132. Mouthparts of the piercing-sucking type with labellum. — 129: Proboscis of the Musca-type (Dipt.) in posterior view, 130: same in lateral view, 131: proboscis of the Musca-type in ventro-lateral view, and 132: the labellum in longitudinal section (after Snodgrass 129, 131, and Matsuda 132)



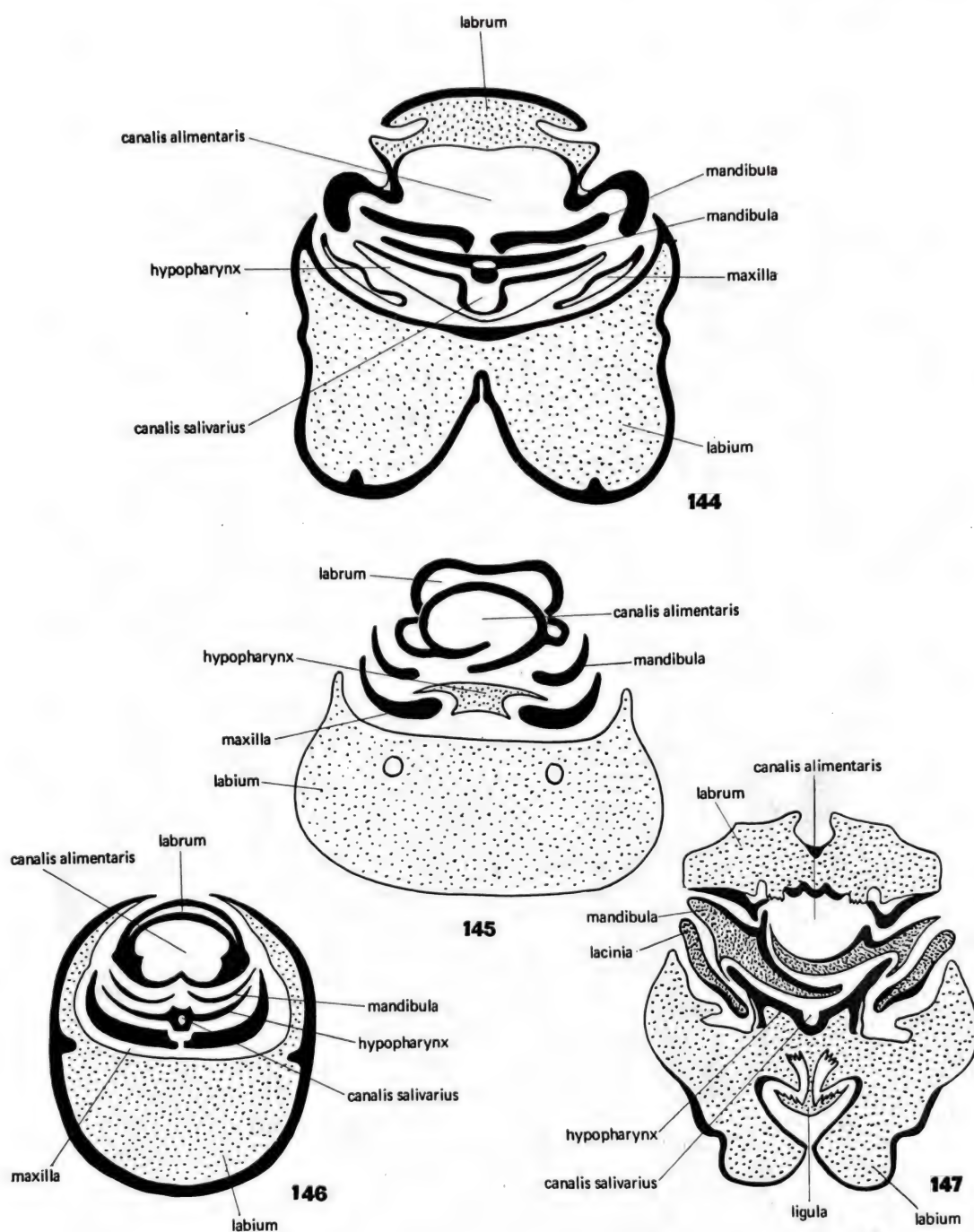
Figs. 133–136. Mouthparts of the piercing-sucking type with labellum. — 133: Hypopharynx of the *Tabanus*-type (Dipt.), 134: same of the *Asilus*-type (Dipt.), 135: galea of the *Tabanus*-type, and 136: cross-section of proboscis of the *Tabanus*-type (after Snodgrass 133, 135, and Shvanvich 134, 136)



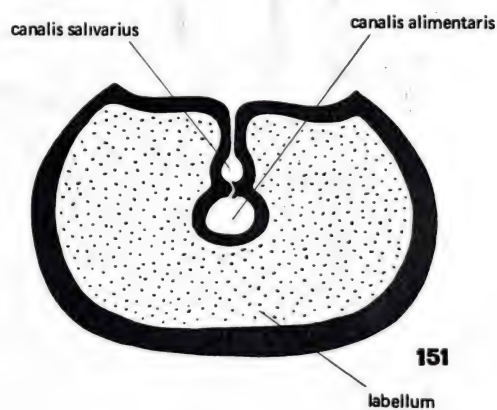
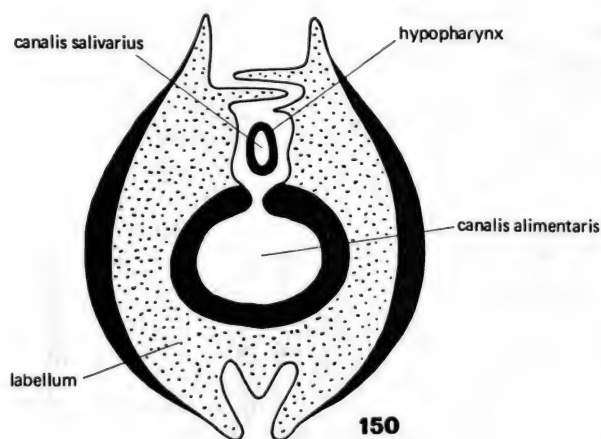
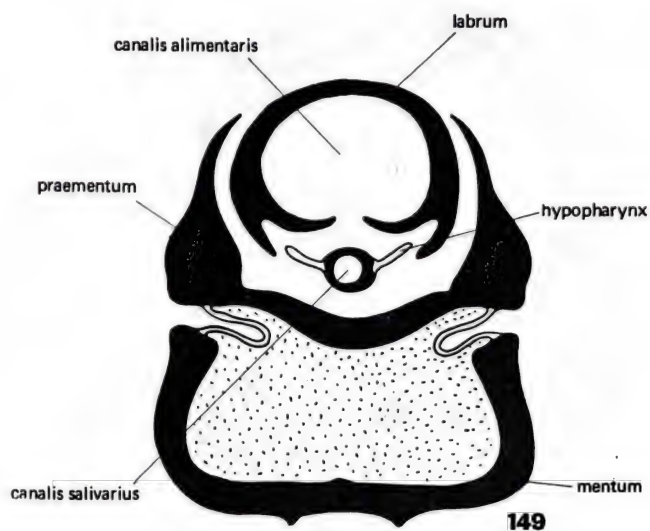
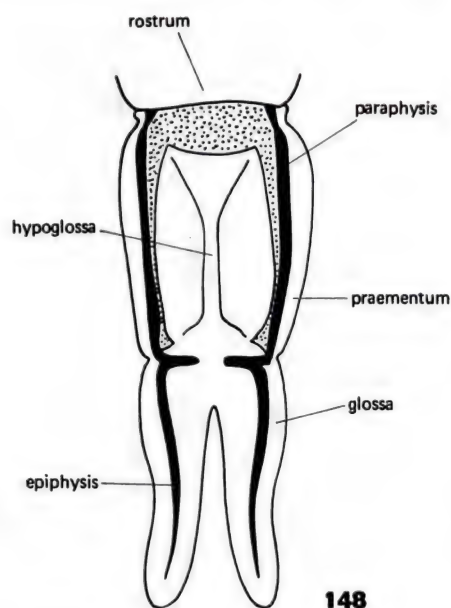
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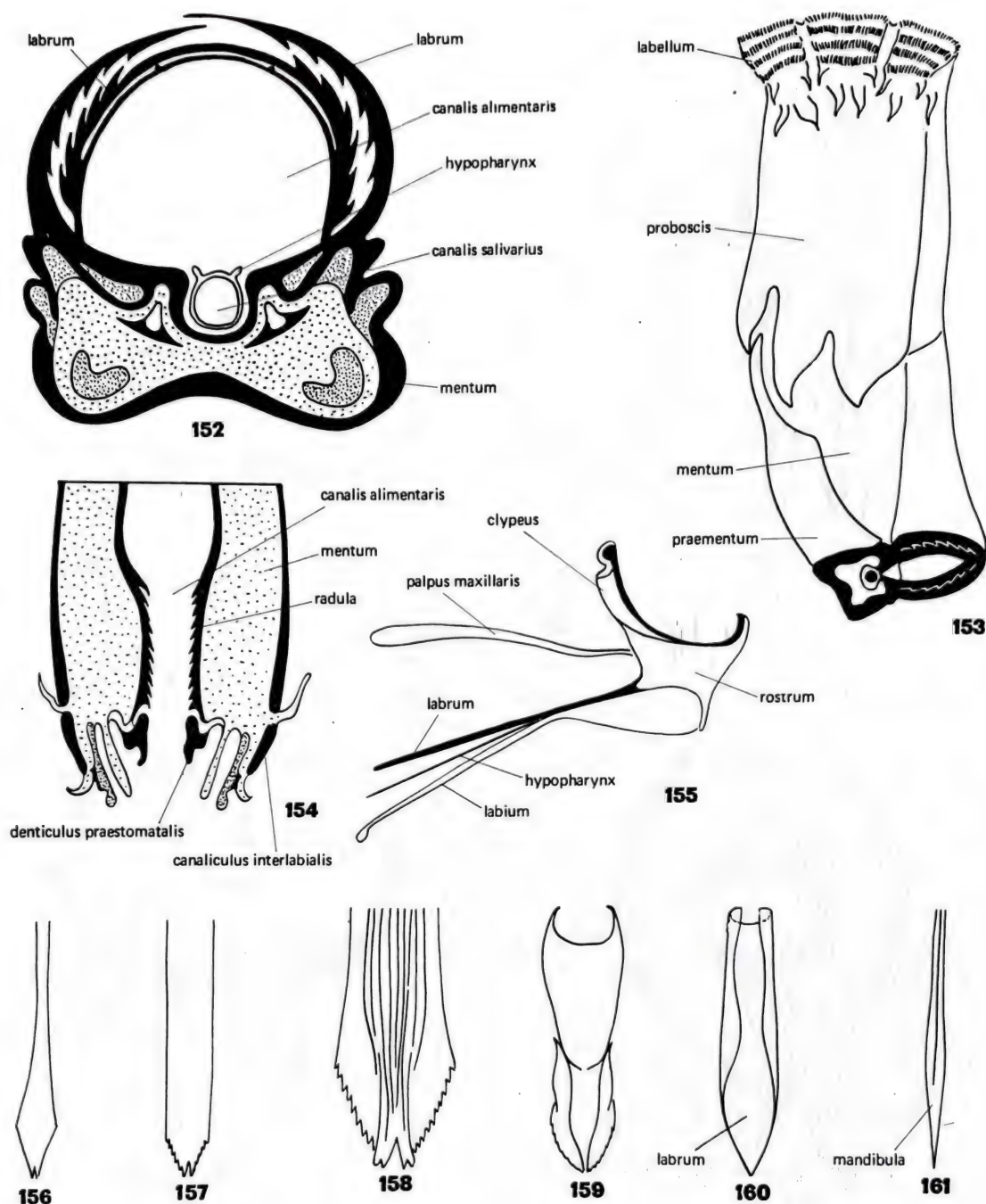
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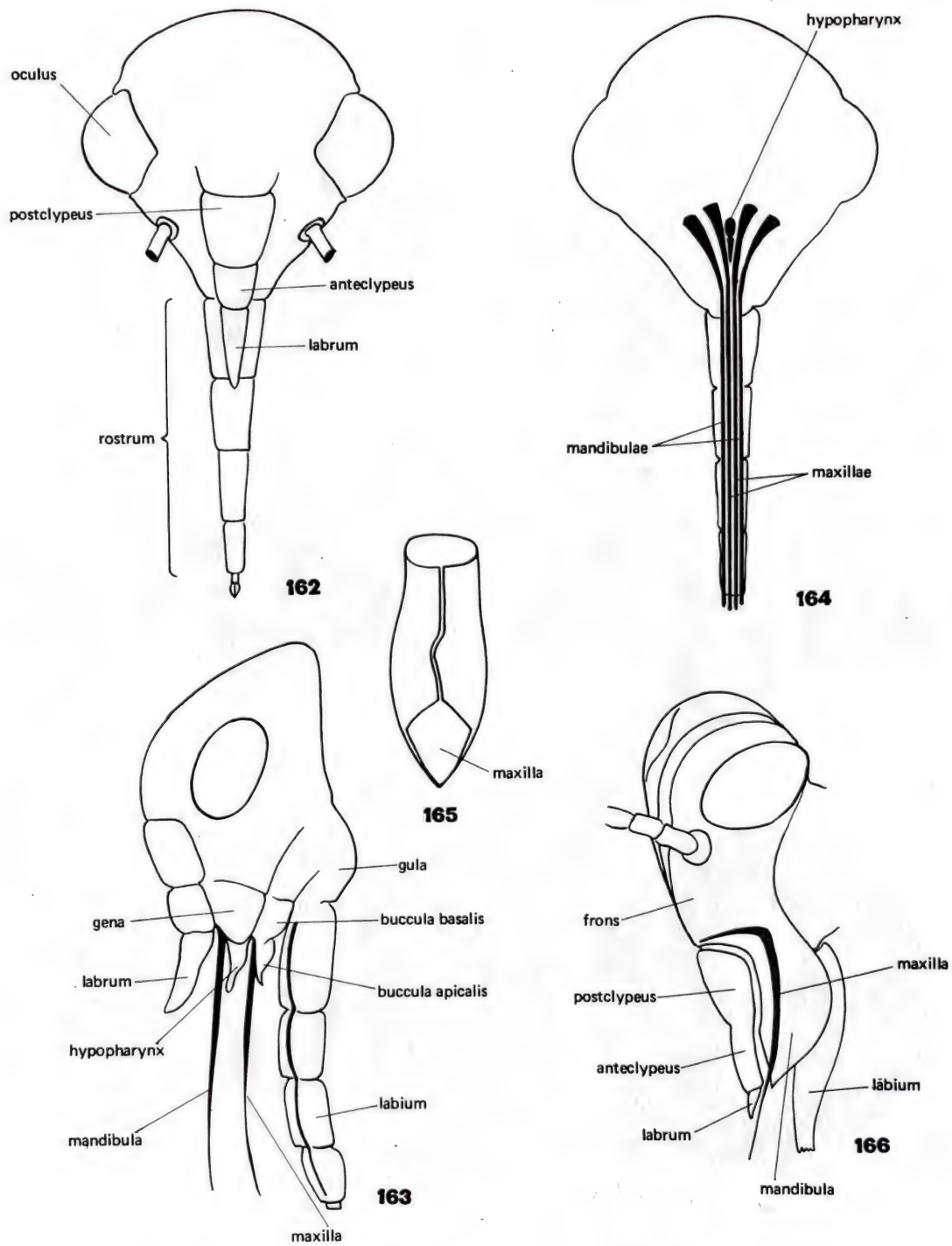
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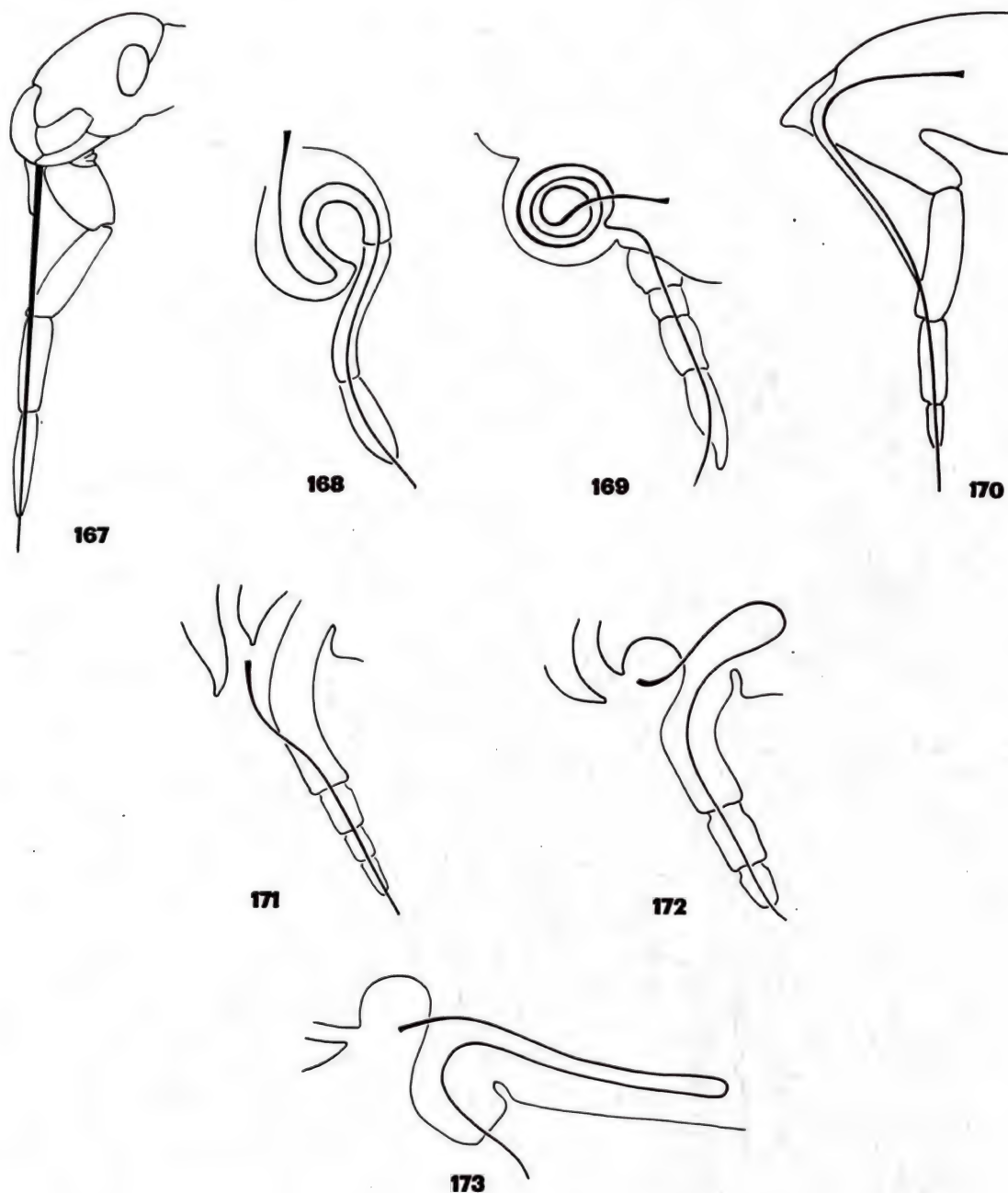
Figs. 148–151. Mouthparts of the piercing-sucking type with five stylets. — 148: Modified labium of a Calypttrata (Dipt.). 149: Cross-section of proboscis of the Lynchia-type (Dipt.). 150–151: Cross-section of labellum of the 150: Cyclopodia-type (Dipt.), and 151: Nycteribosca-type (Dipt.) (after Matsuda 148, and Shvanvich 149–151)



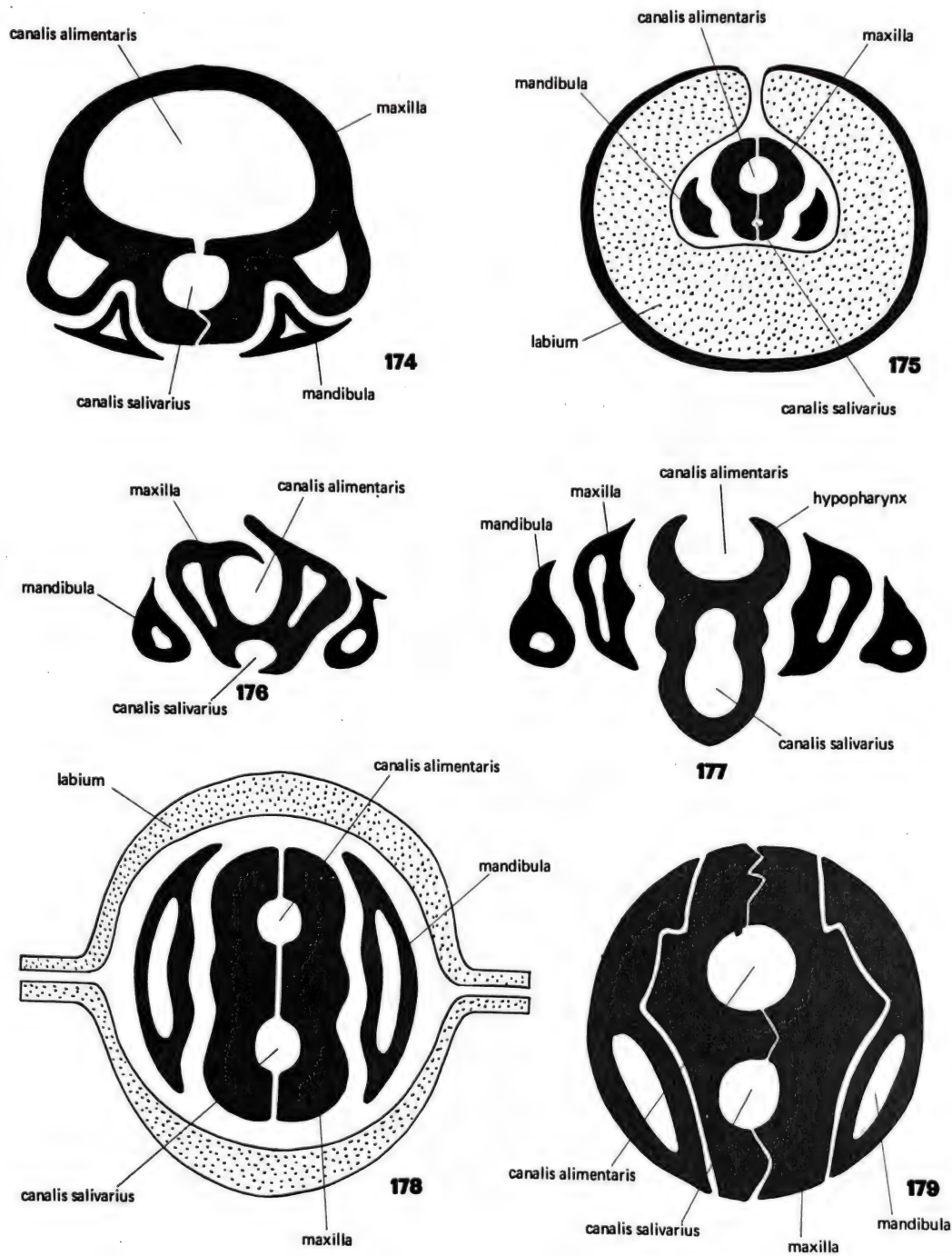
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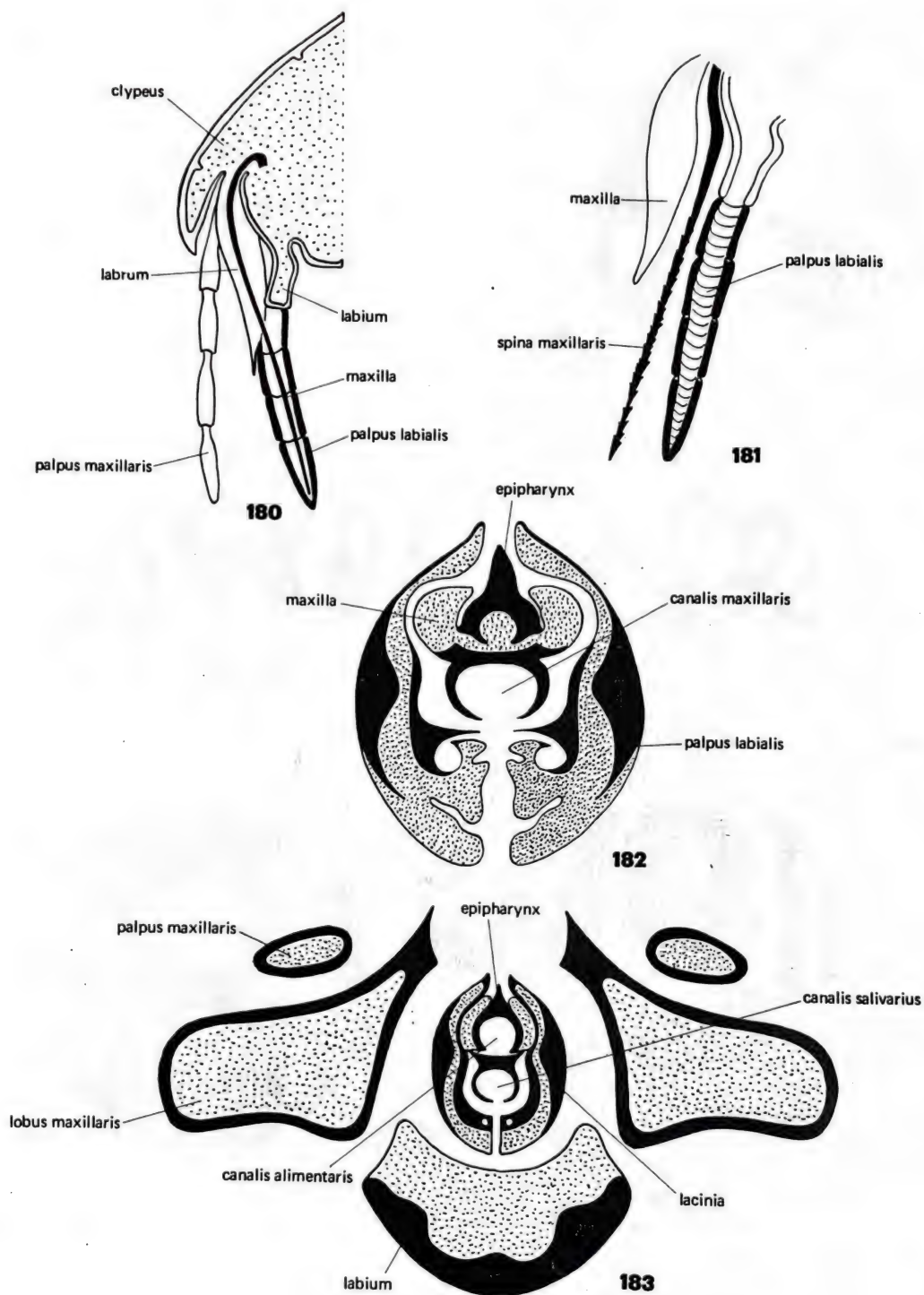
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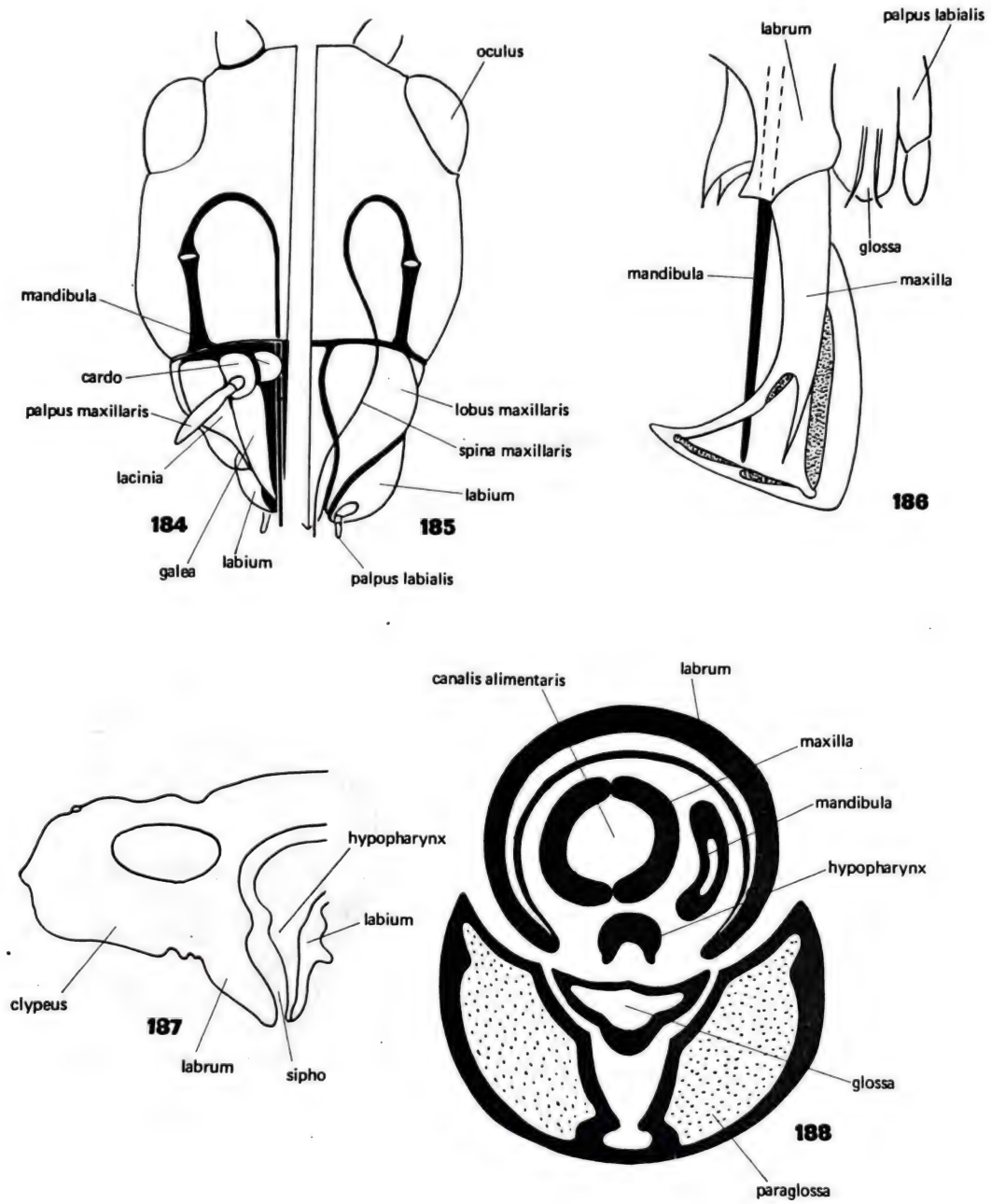
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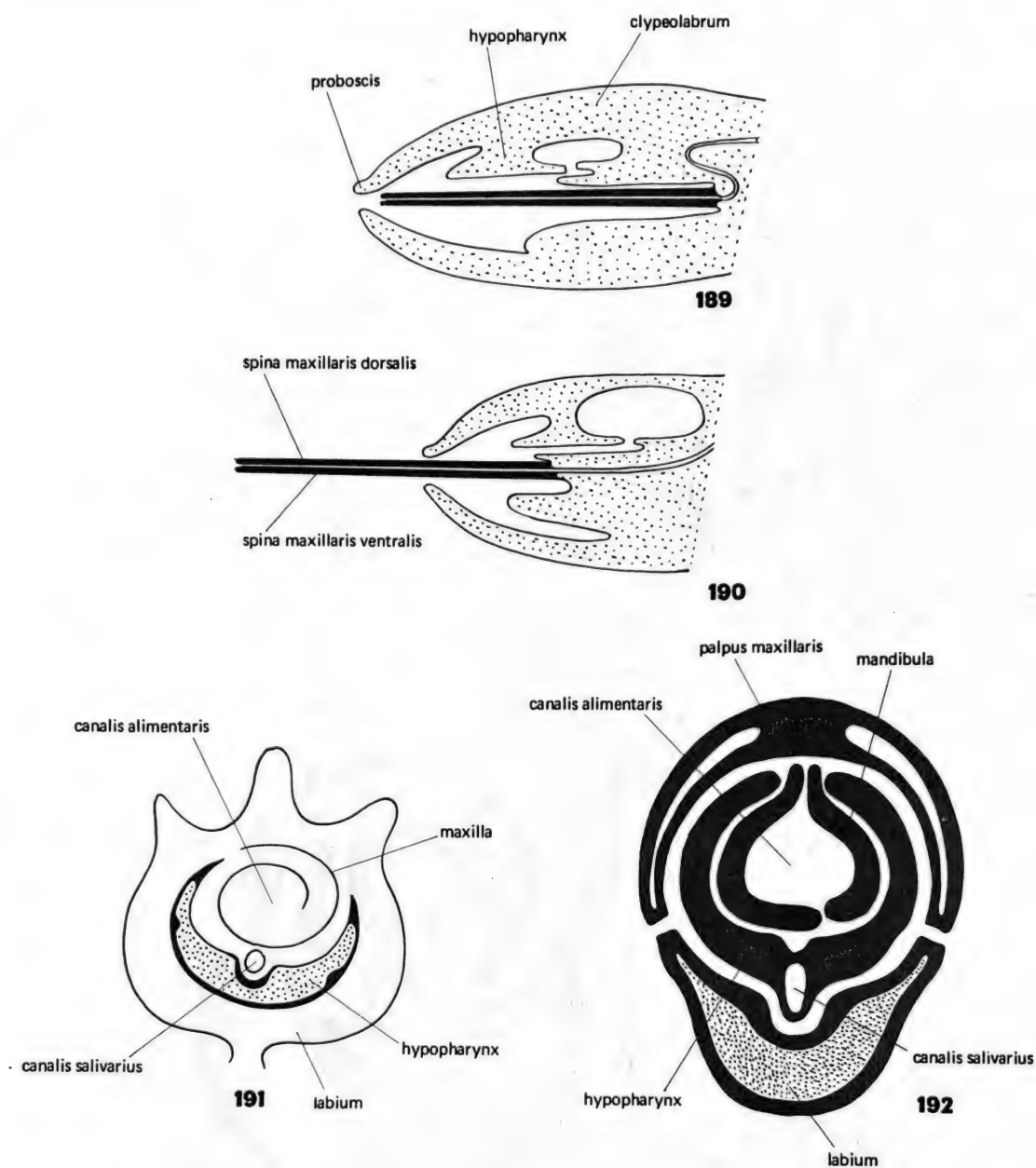
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THE THORAX

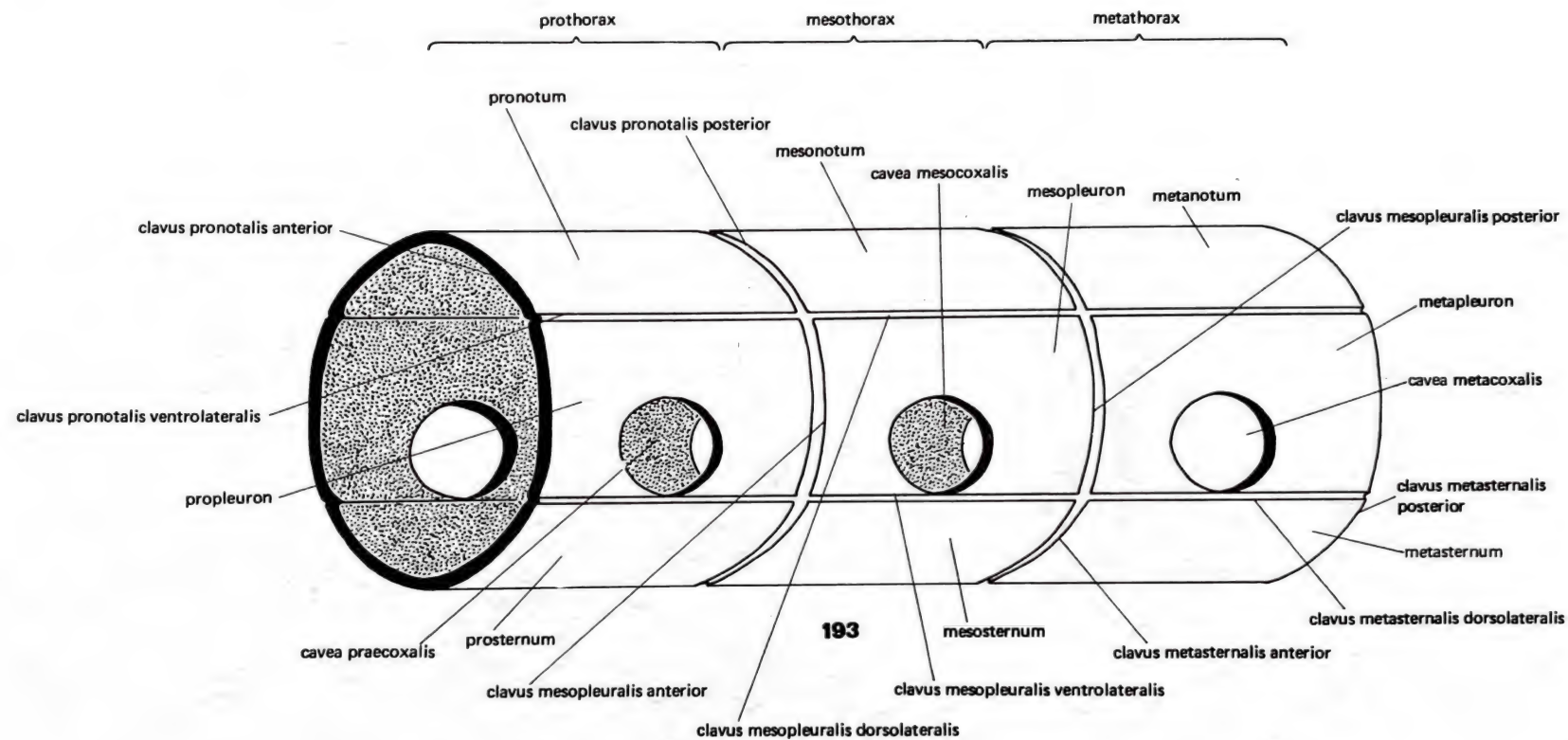


Fig. 193. Diagrammatic representation of the wingless thorax

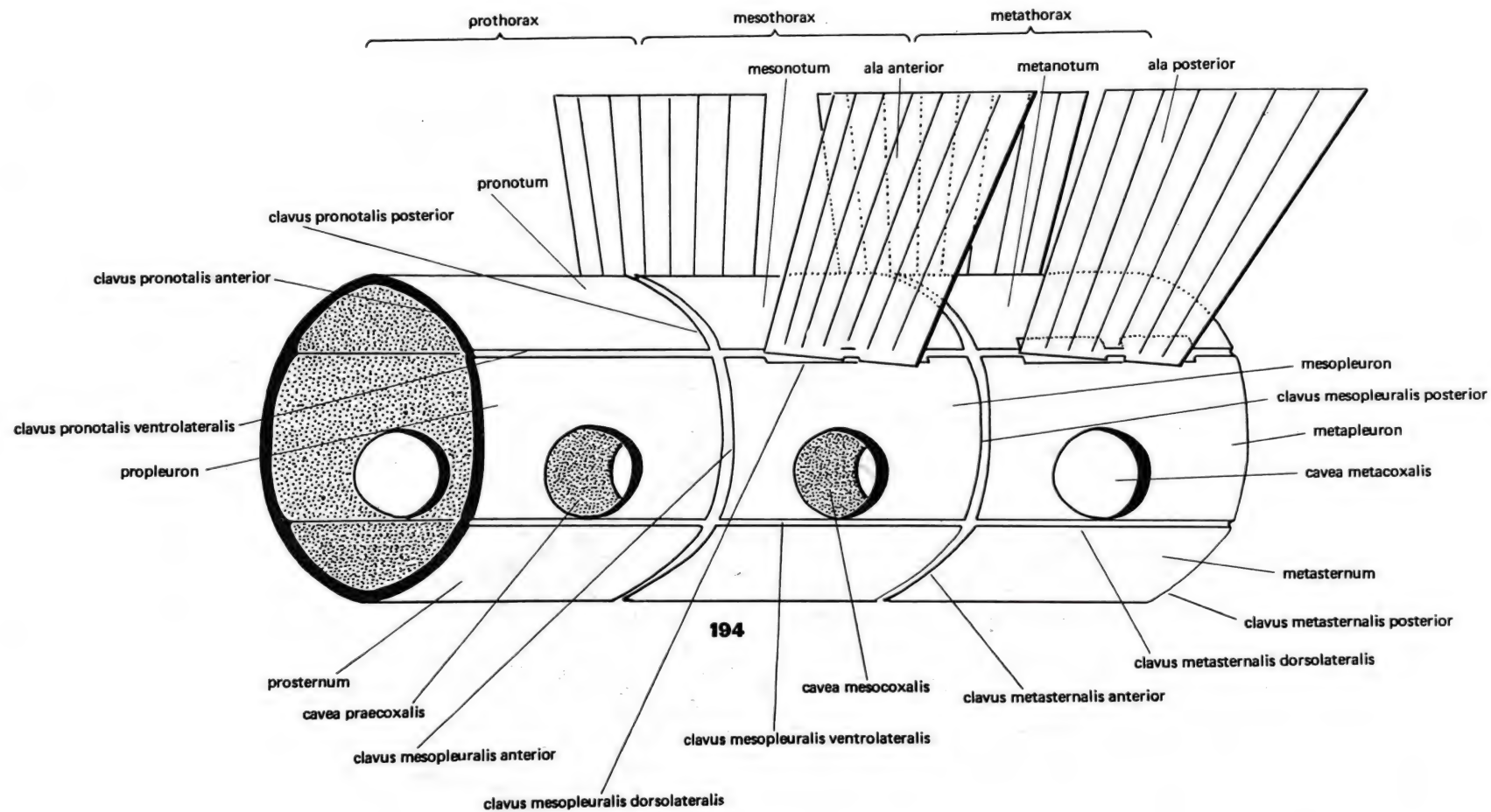


Fig. 194. Diagrammatic representation of the winged thorax

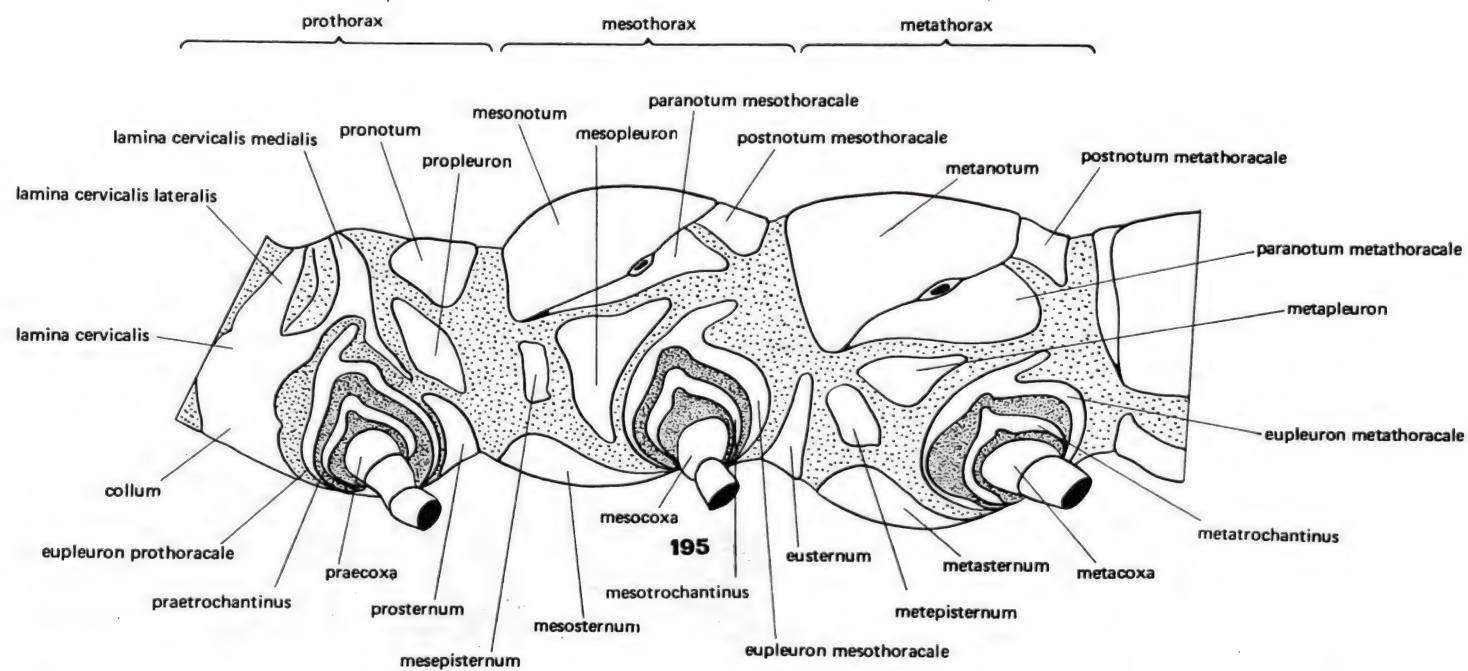
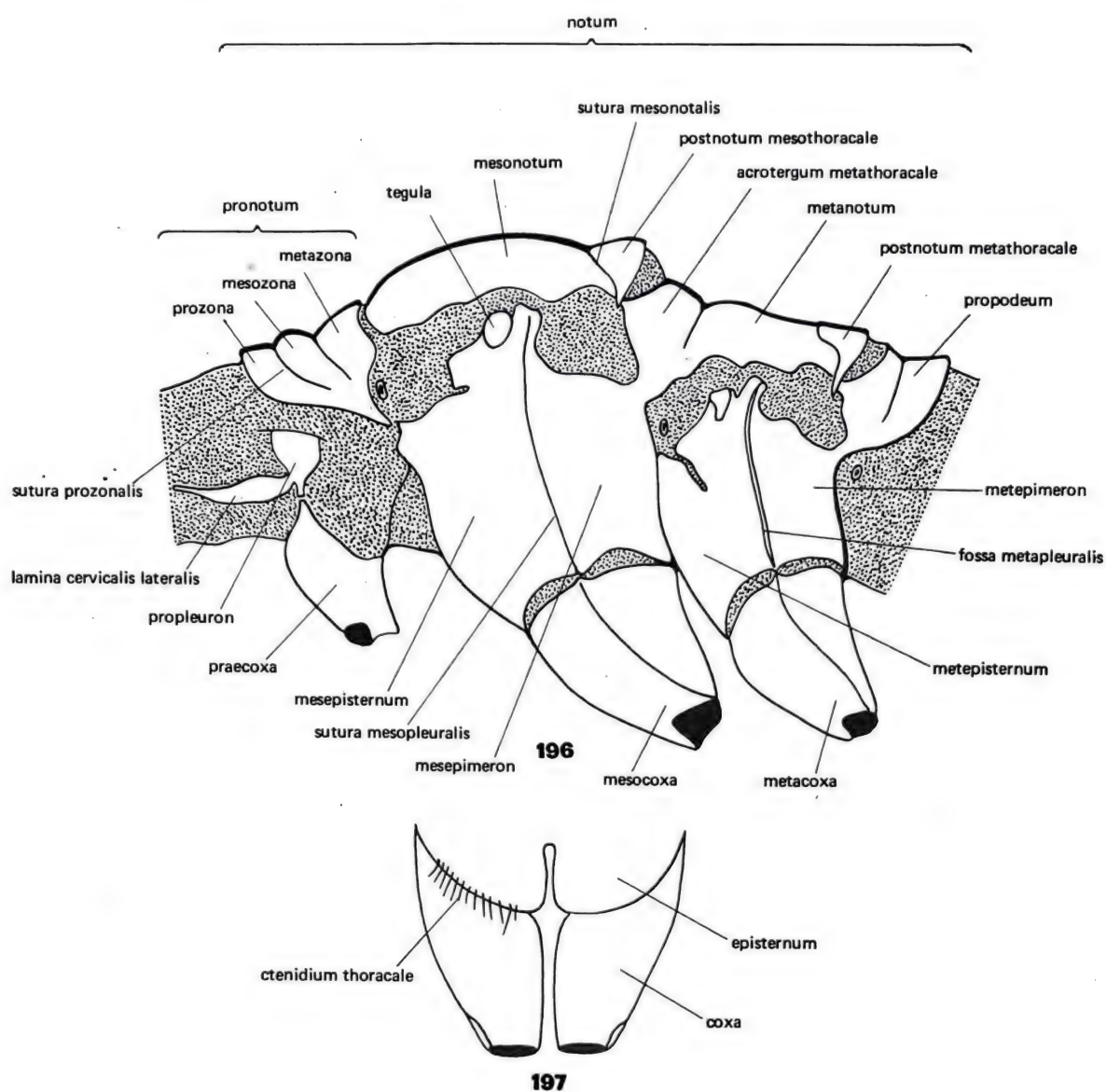
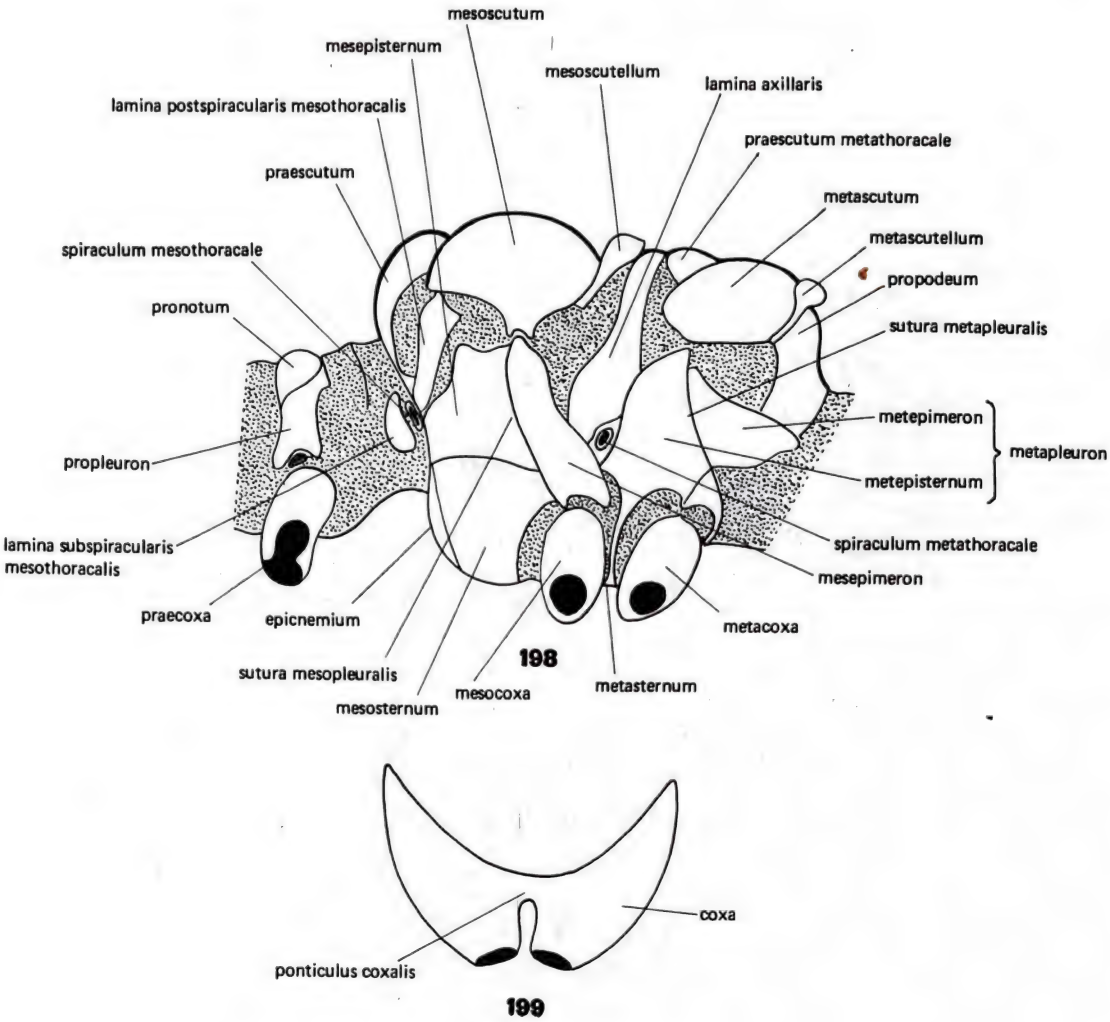


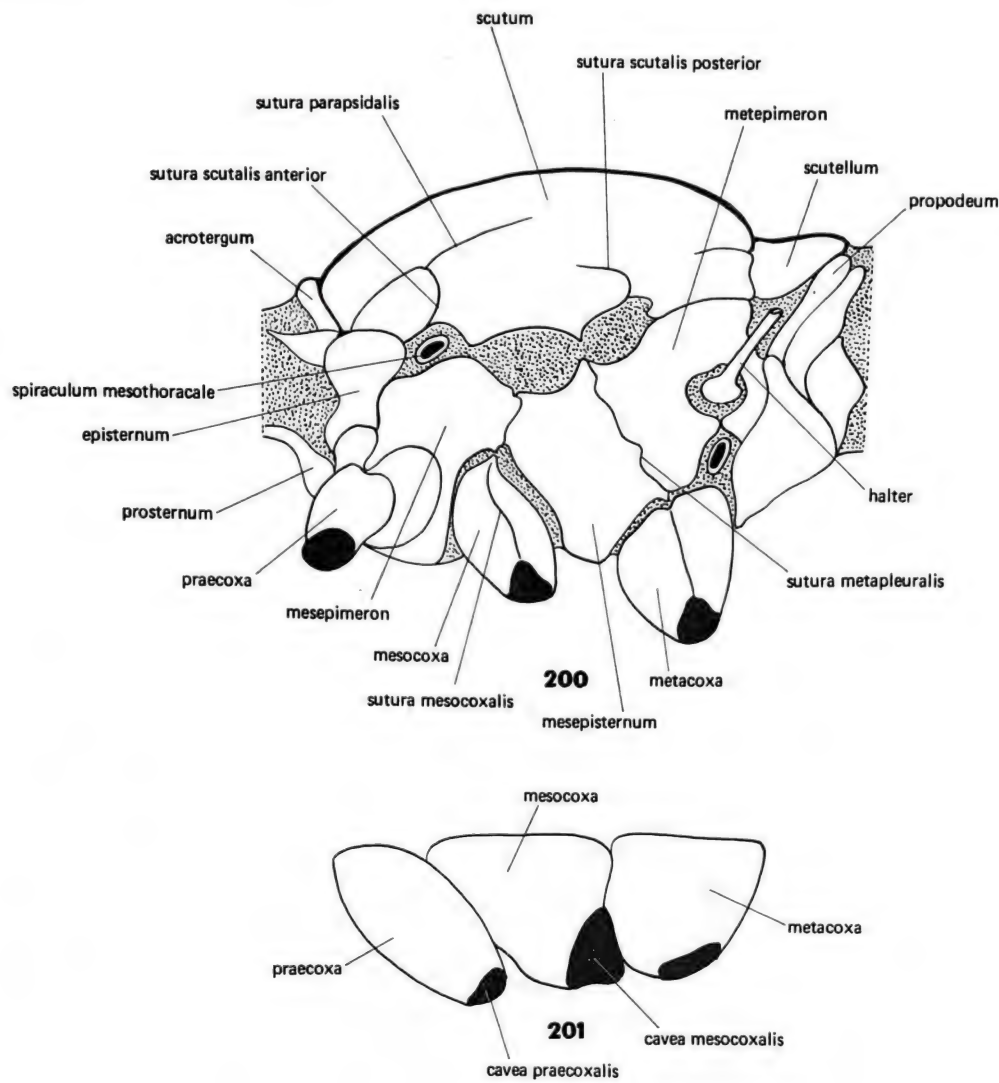
Fig. 195. Thorax of the primitive insect in lateral view (after Matsuda)



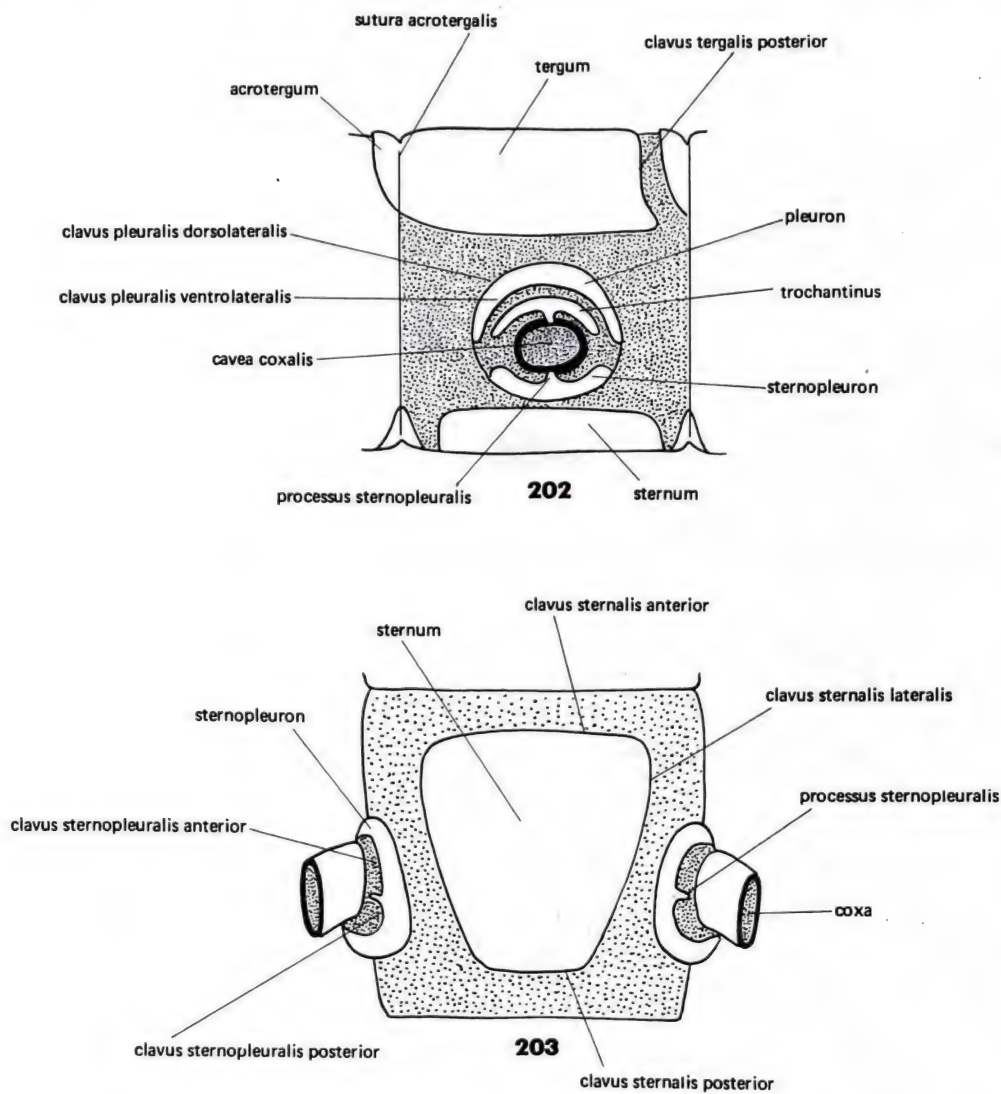
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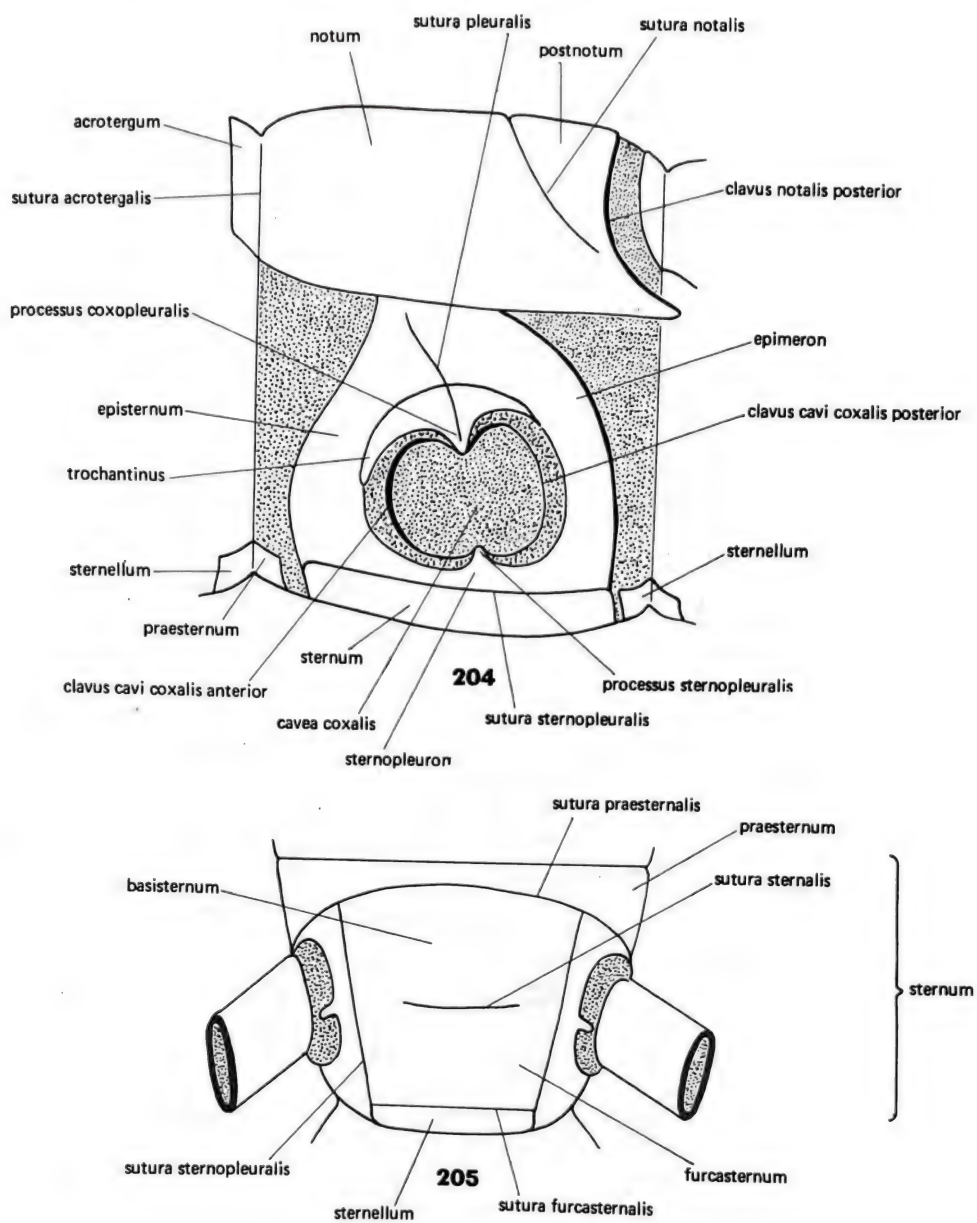
Figs. 198–199. Thorax of the Psocoptera-type. — In lateral view, and 199: in frontal view (after Cope)



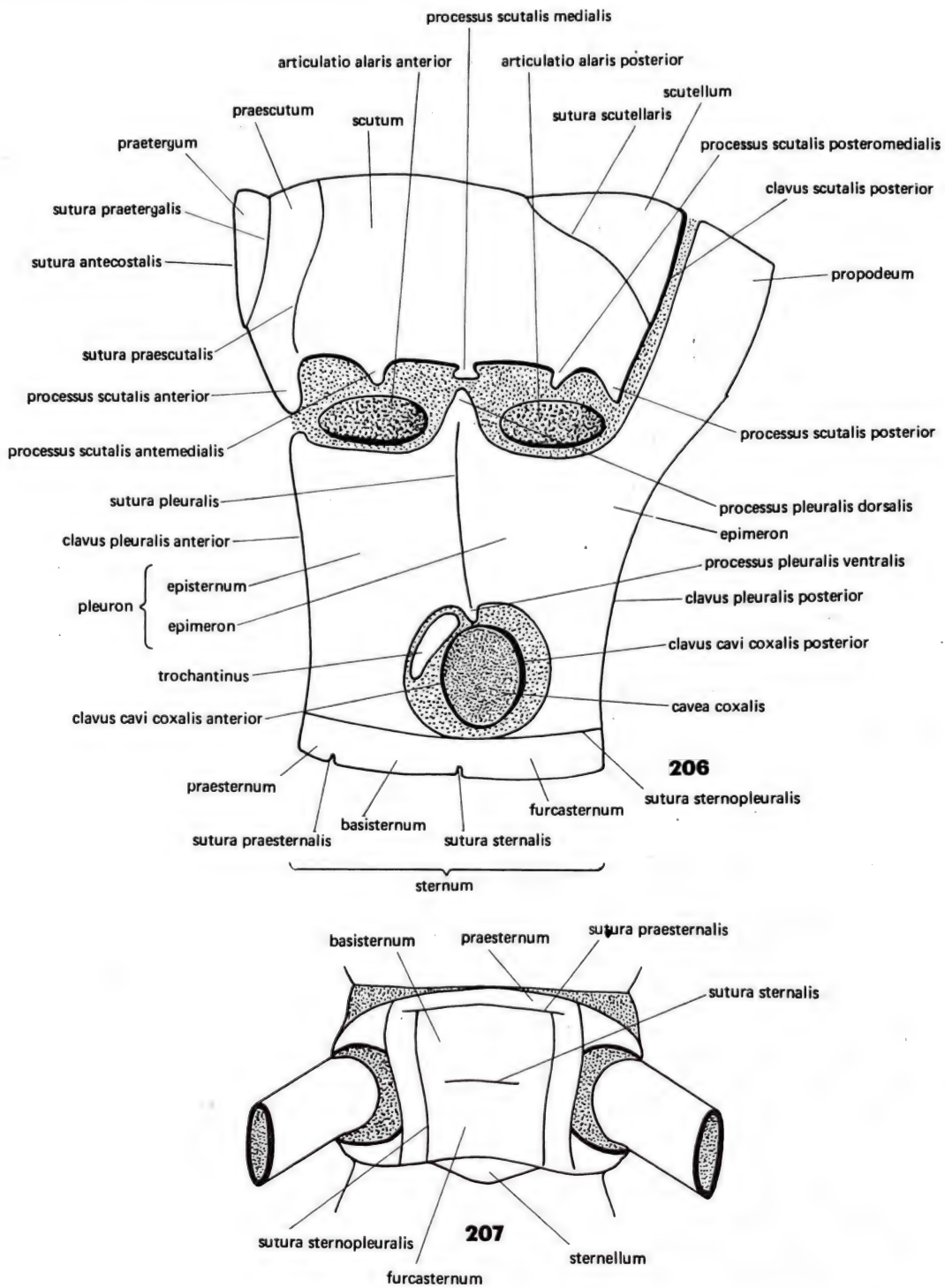
Figs. 200–201. Thorax of the Diptera-type. — 200: In lateral view, and 201: set of close coxae (after Rees)



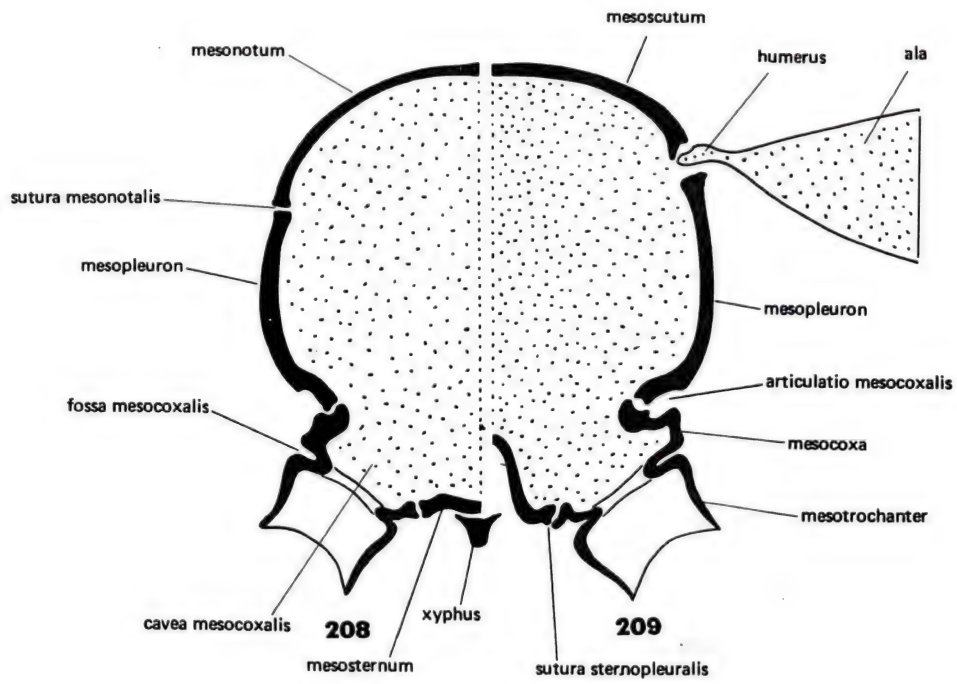
Figs. 202–203. Schematic drawing of a thoracic segment. — 202: In lateral view, and 203: in ventral view (after Snodgrass)



Figs. 204–205. Schematic drawing of a wingless thoracic segment. — 204: In lateral view, and 205: in ventral view (after Snodgrass)



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Figs. 208–209. Schematic drawing of the mesothoracic segment in cross-section. — 208: Wingless, and 209: winged halves

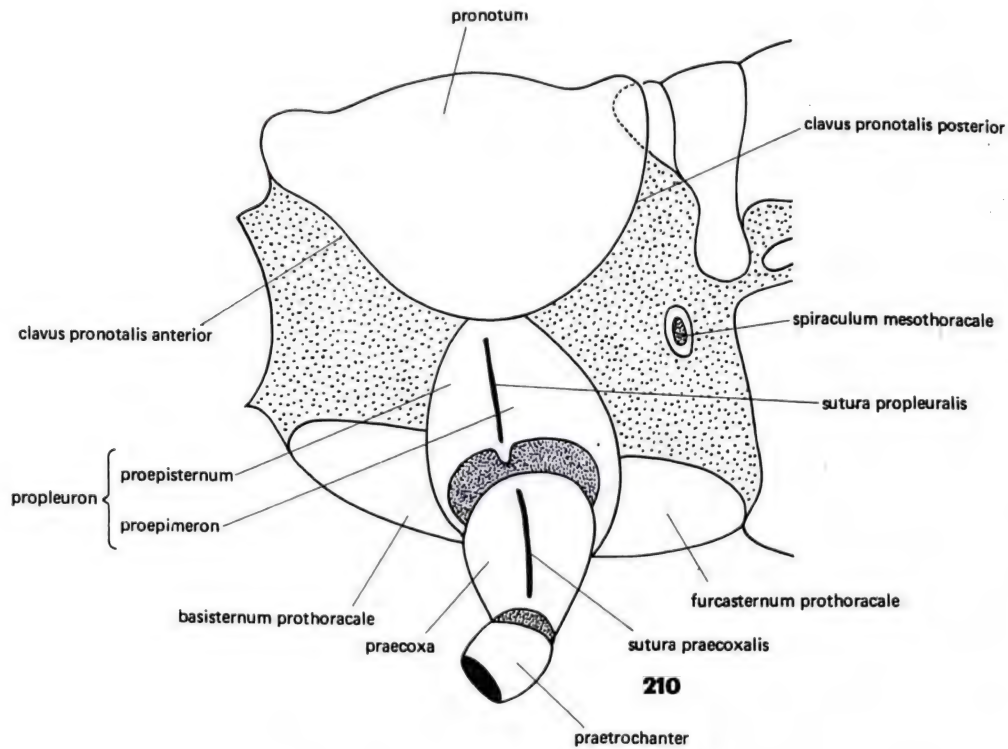
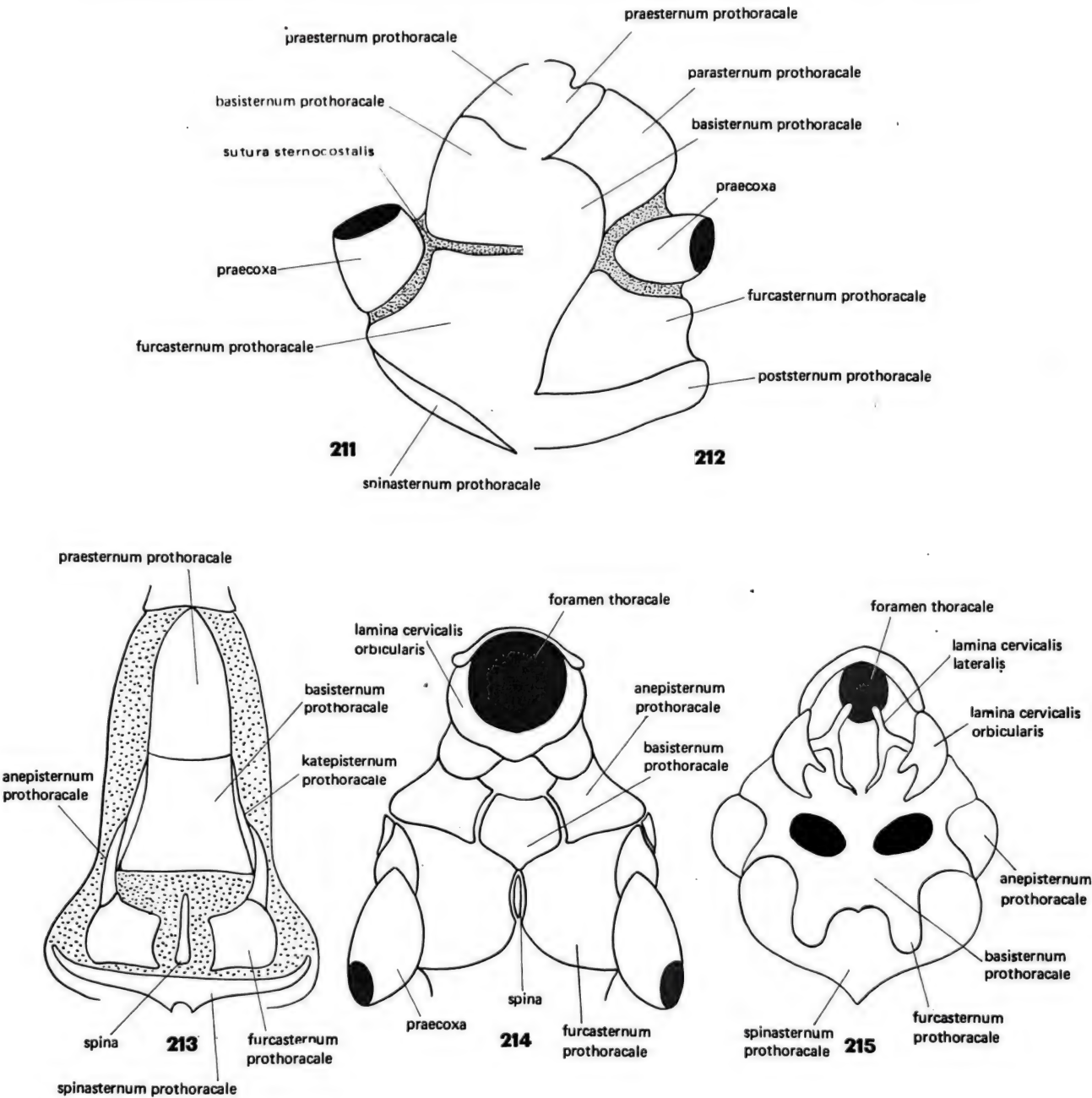
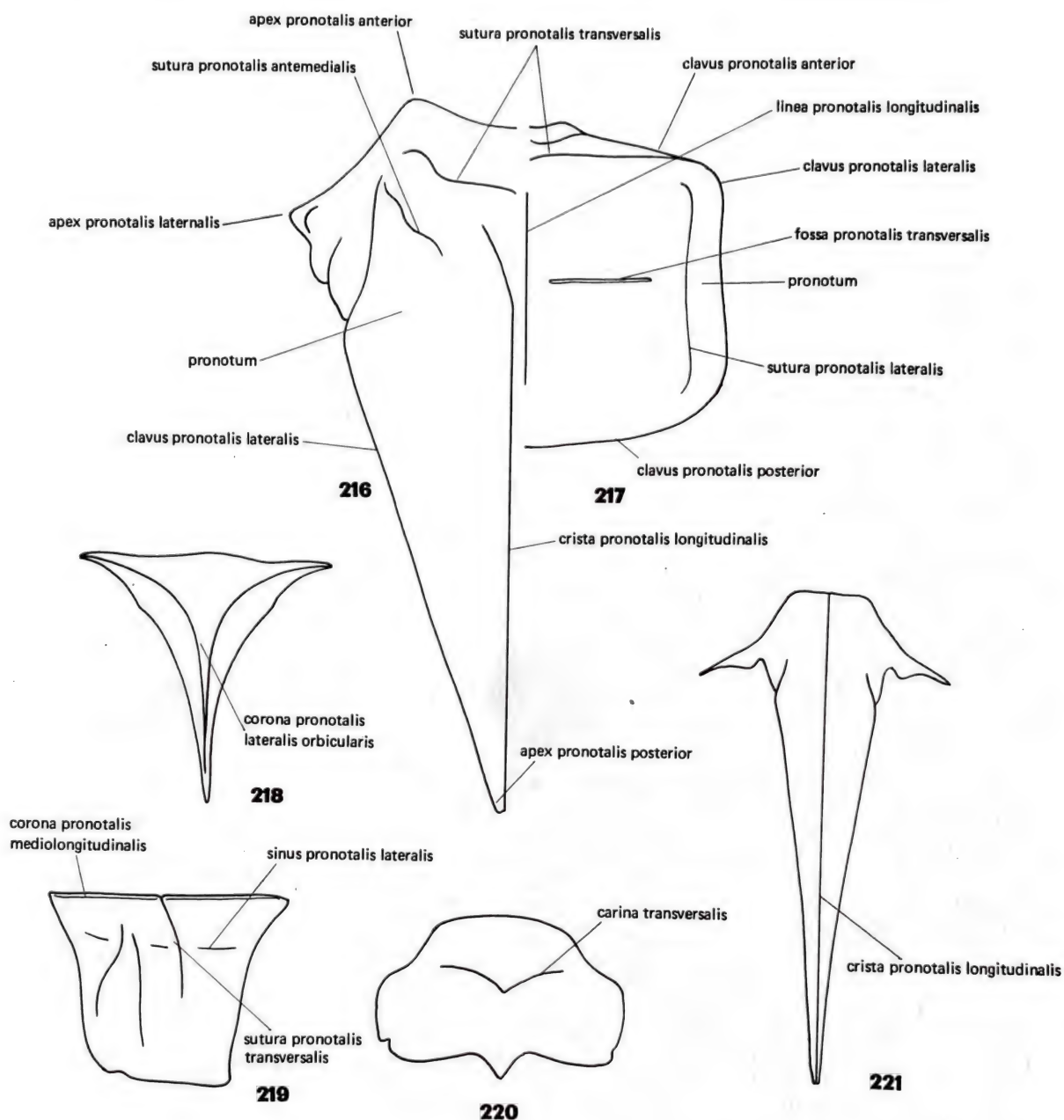


Fig. 210. Schematic drawing of the prothorax in lateral view



Figs. 211–215. The prothorax in ventral view. – 211–212: The Apterygota-types, 211: *Eosentomon* (Protura), and 212: *Japyx* (Diplura). 213–215: The Pterygota-types, 213: *Agulla* (Raphidiopt.), 214: *Zorotypus* (Zorapt.), and 215: *Hepialus* (Lepidopt.) (after Matsuda)



Figs. 216–221. The prothorax in dorsal view. — 216: *Mazzaredia* (Orthopt.), 217: *Carcinophora* (Dermapt.), 218: *Ceresa* (Homopt.), 219: *Arcyptera* (Orthopt.) (in lateral view), 220: *Agrion* (Odon.), and 221: *Criotettix* (Orthopt.)

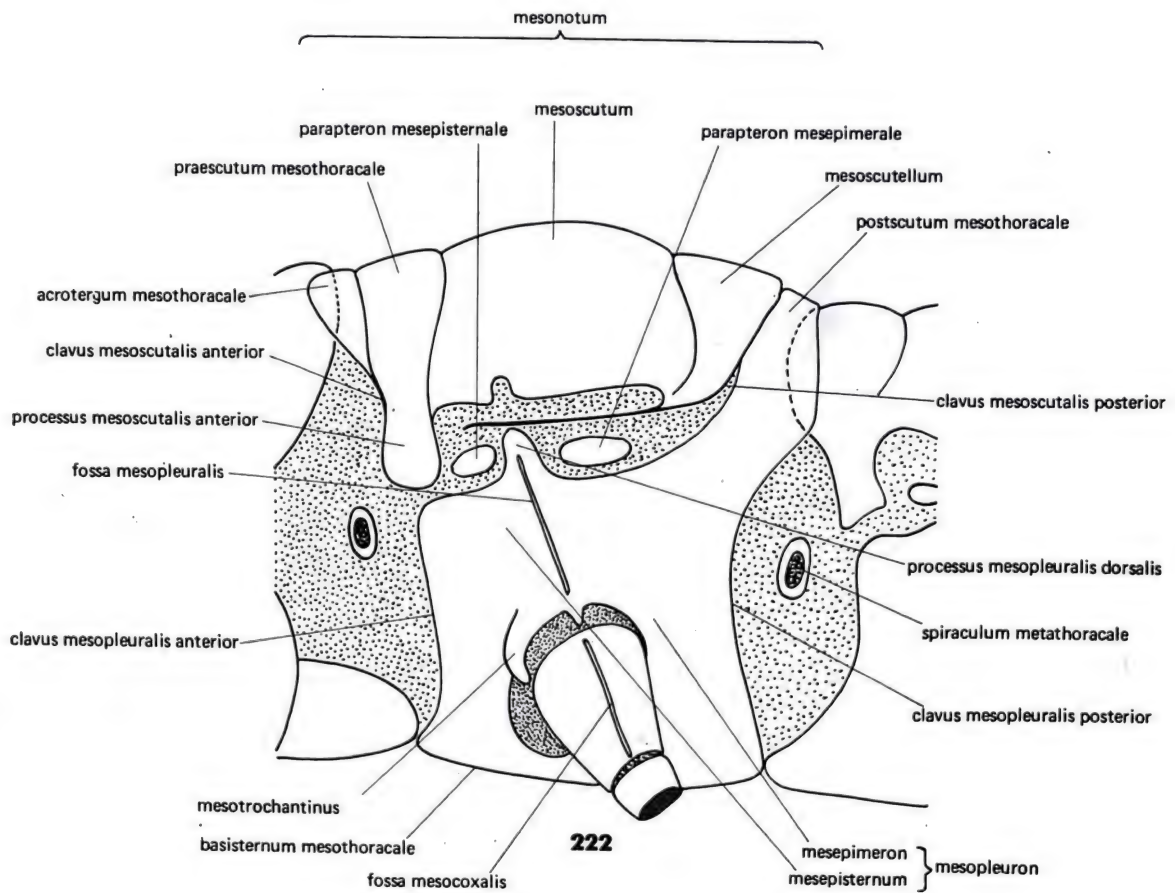
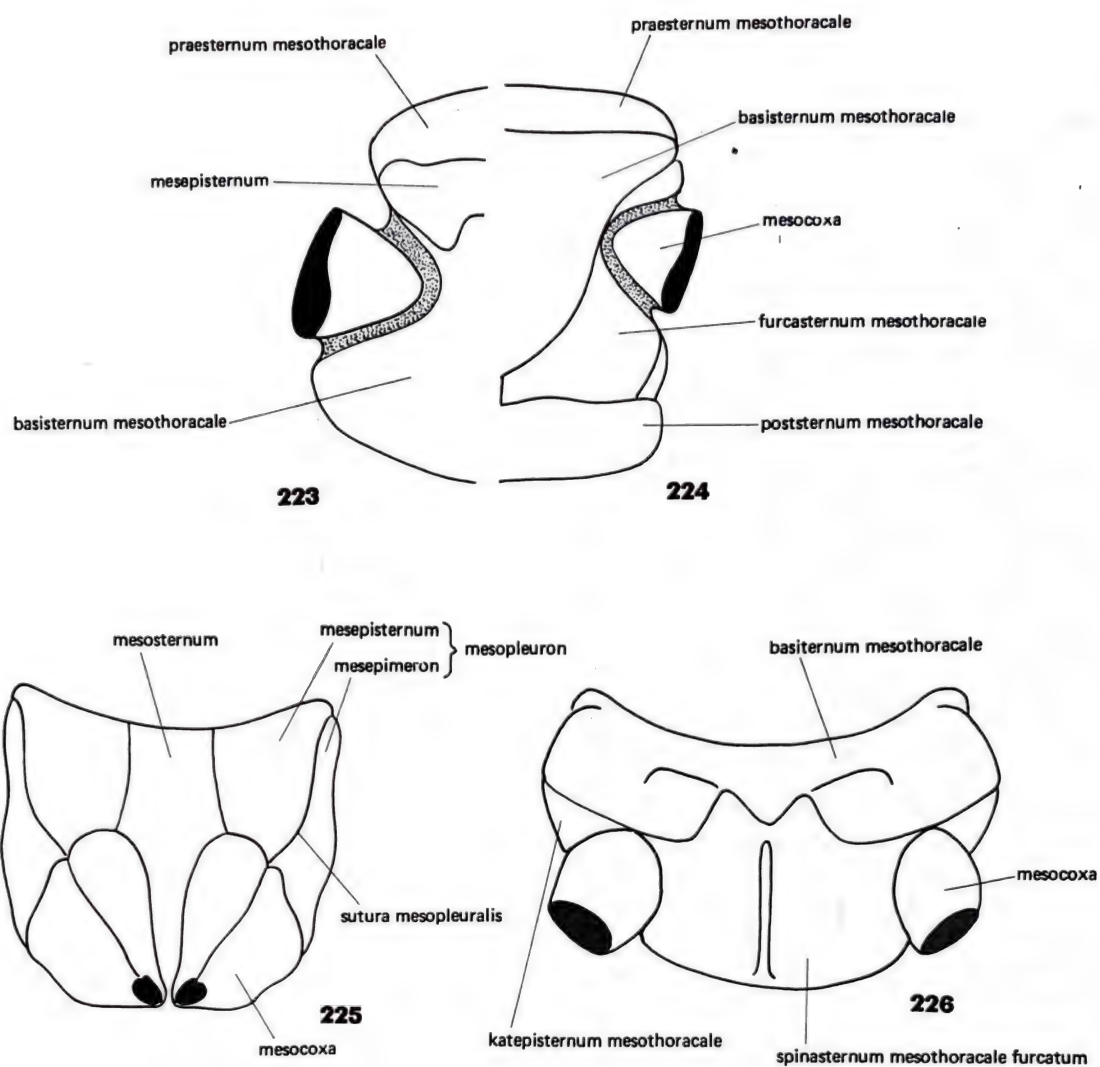


Fig. 222. Schematic drawing of the mesothorax in lateral view



Figs. 223–226. The mesothorax in ventral view. — 223–224: The Apterygota-types, 223: *Eosentomon* (Protura), and 224: *Japyx* (Diplura). 225–226. The Pterygota-types, 225: *Papilio* (Lepidopt.), and 226: *Perla* (Plecopt.) (after Matsuda 225–226)

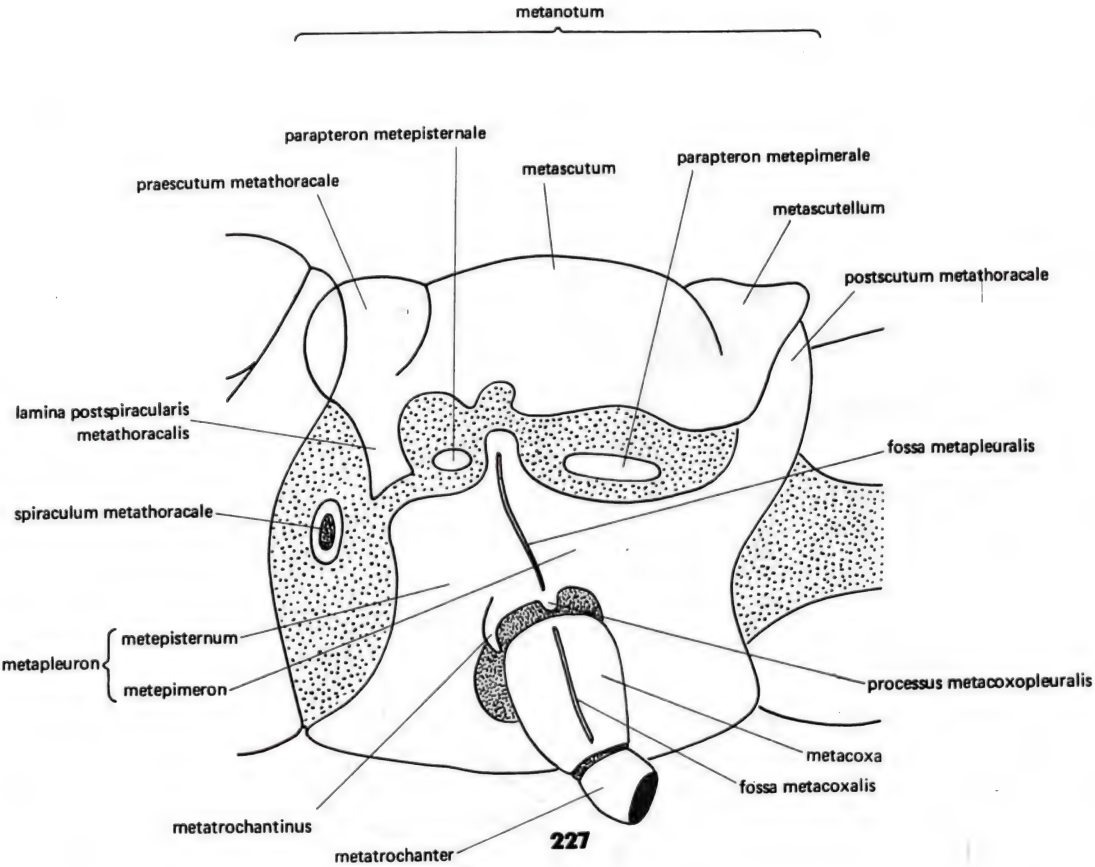
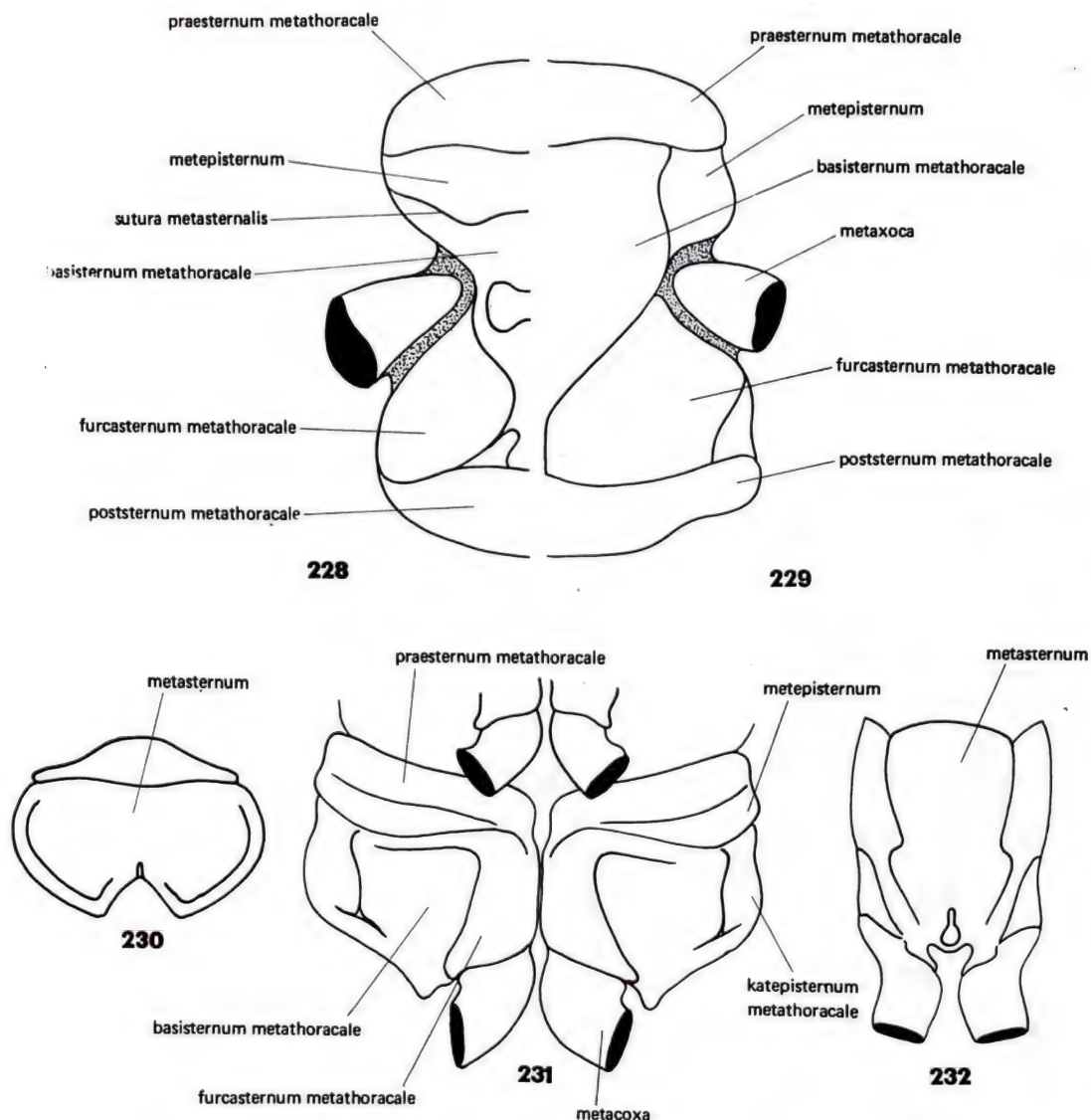


Fig. 227. Schematic drawing of the metathorax in lateral view



Figs. 228–232. The metathorax in ventral view. – 228–229: The Apterygota-types, 228: *Eosentomon* (Protura), and 229: *Japyx* (Diplura). – 230–232: The Pterygota-types, 230: *Belocephalus* (Orthopt.), 231: *Blabera* (Blatt.), and 232: *Hierodula* (Orthopt.) (after Matsuda 230–232)

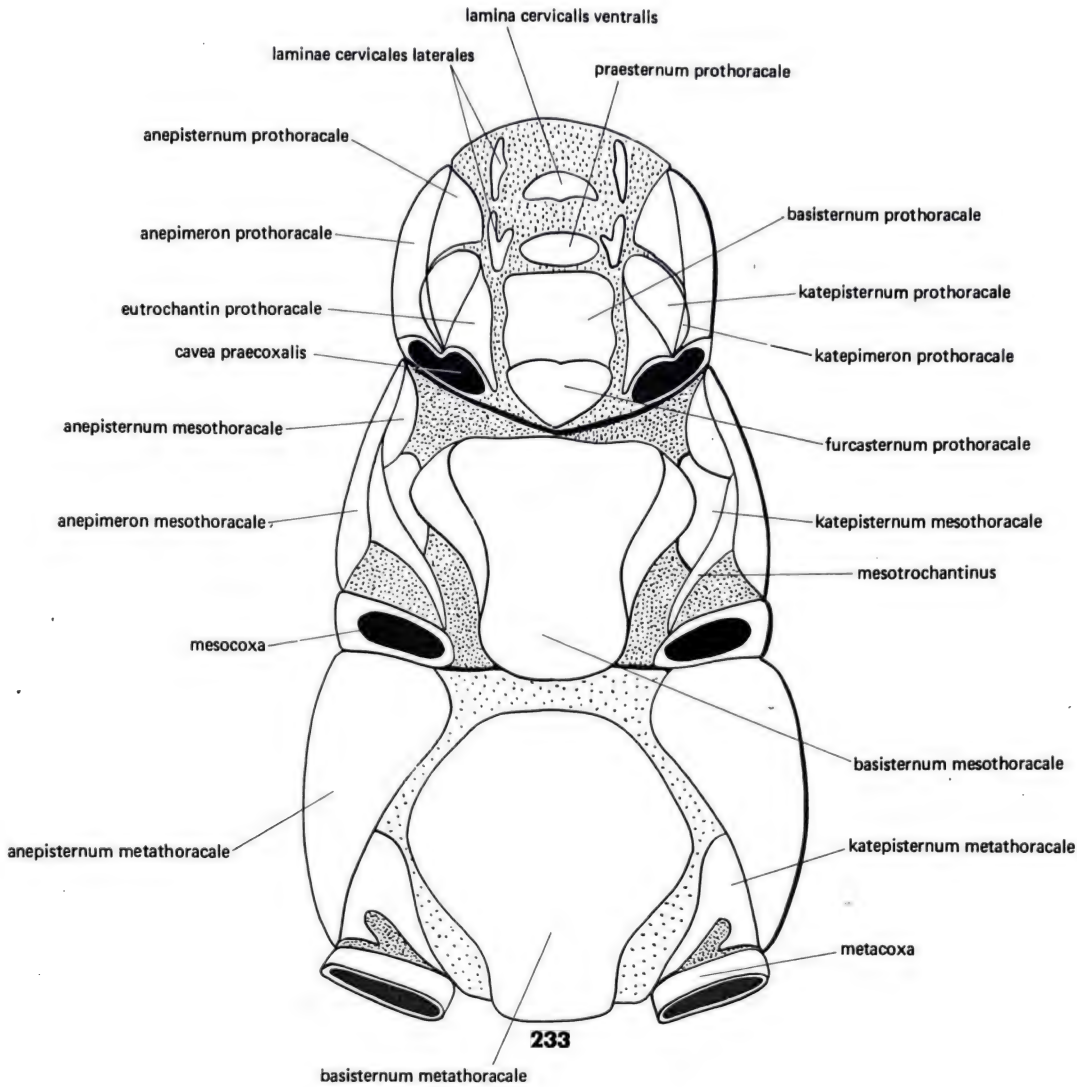
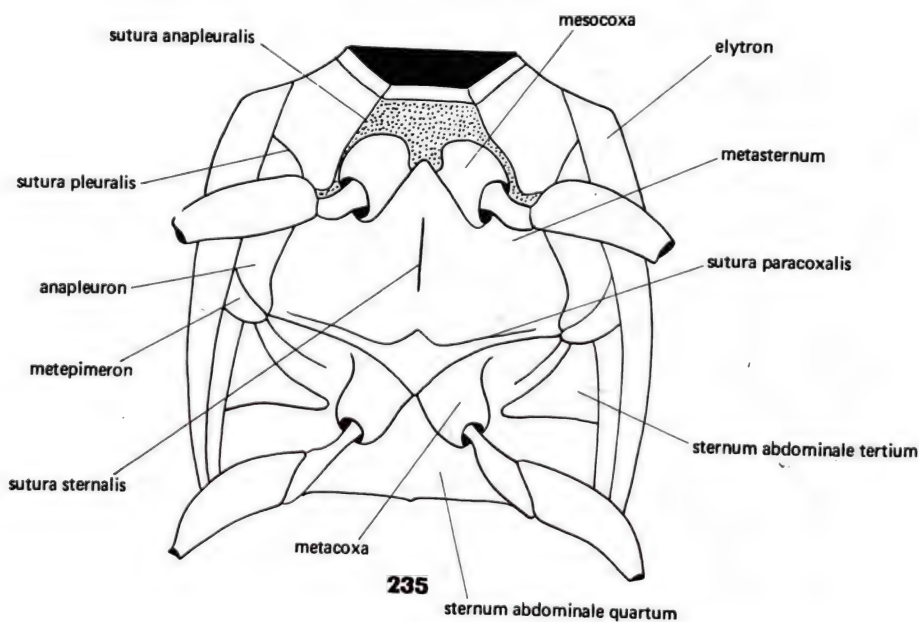
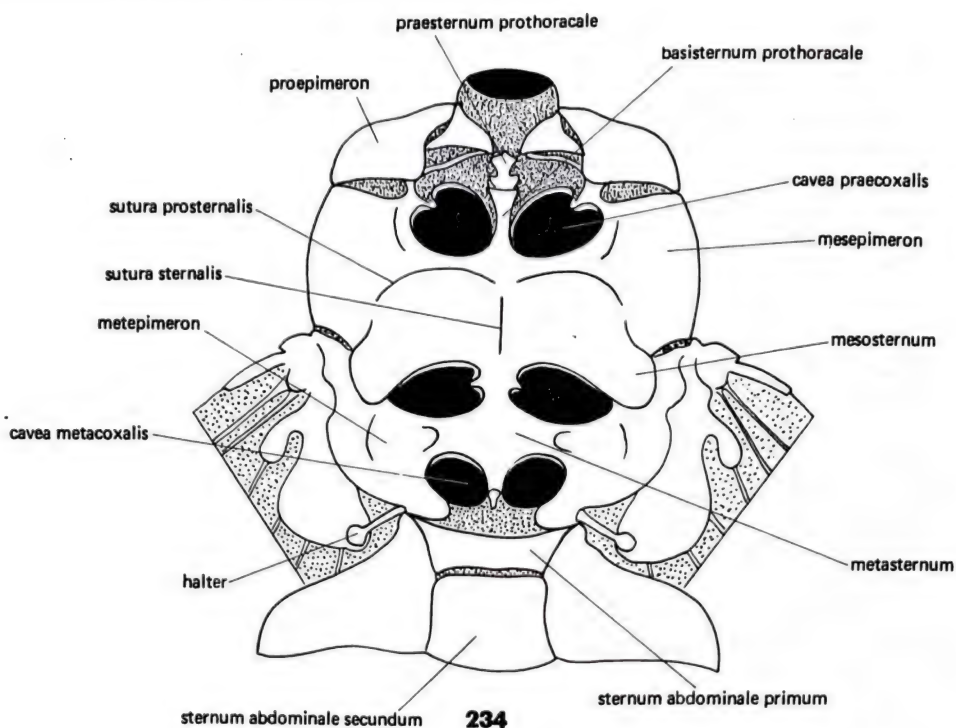
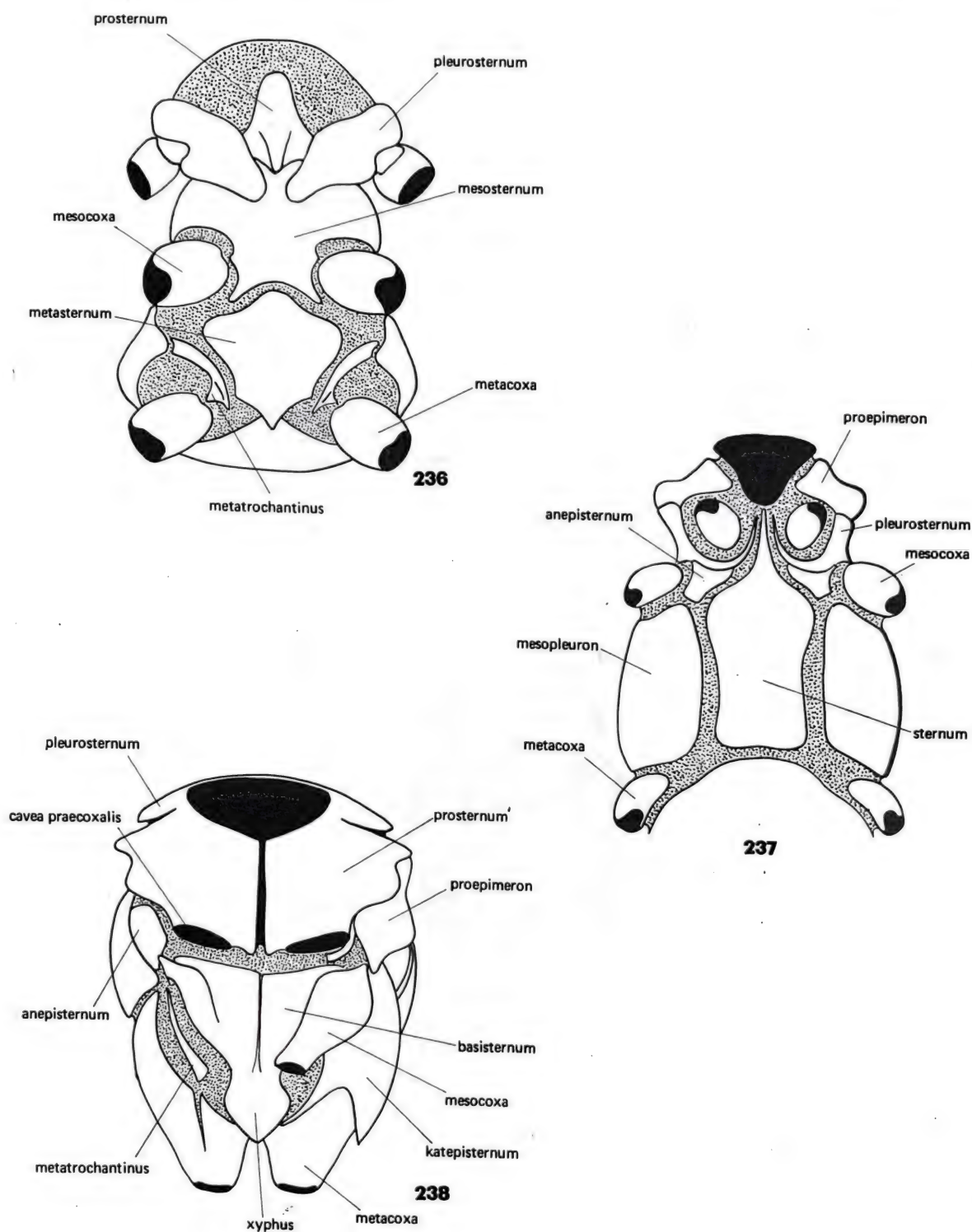


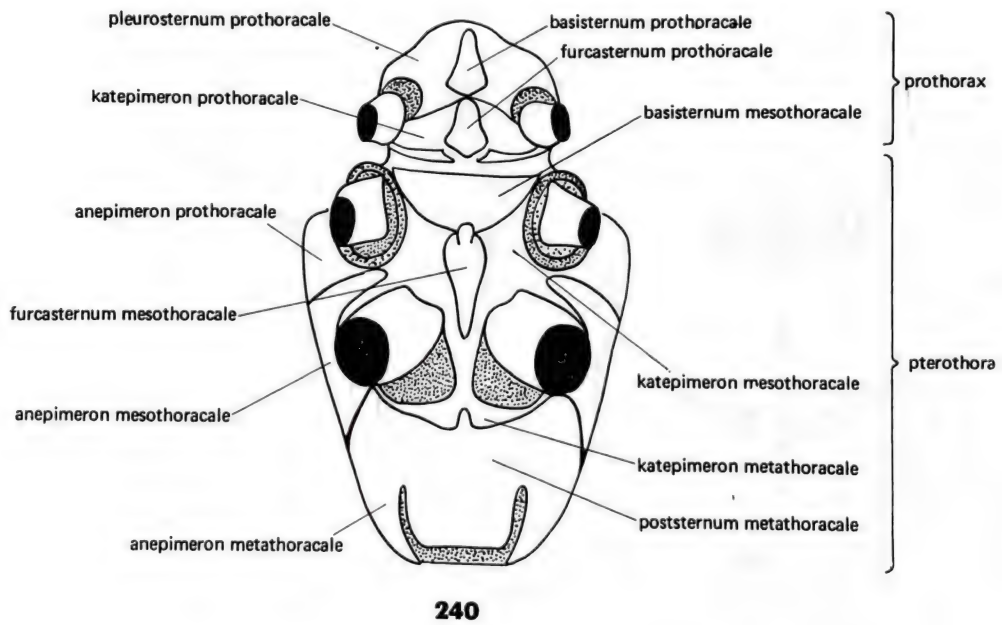
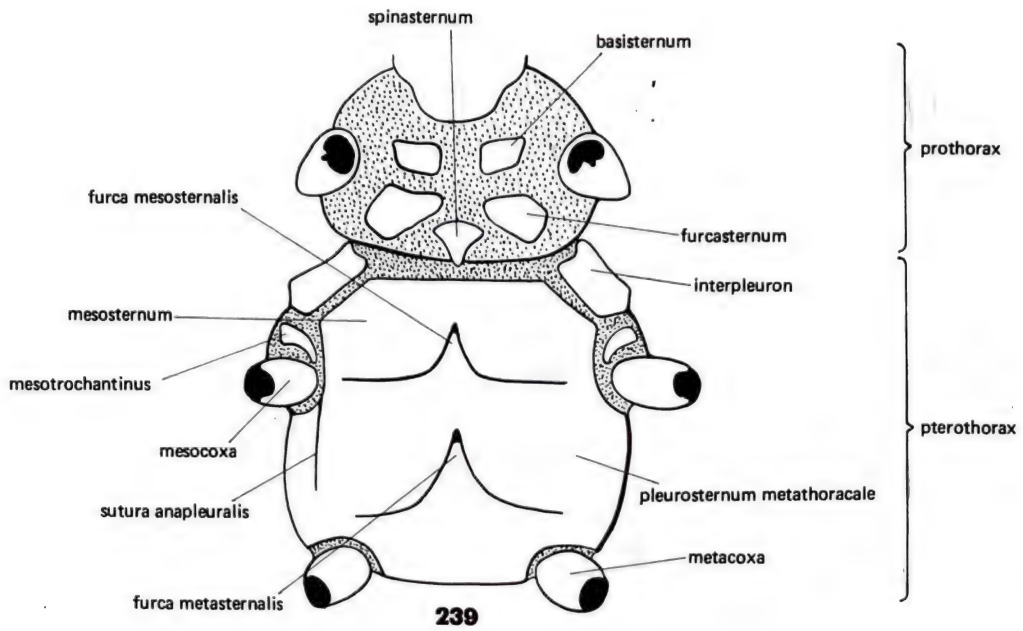
Fig. 233. The thorax of the Dermaptera-type in ventral view



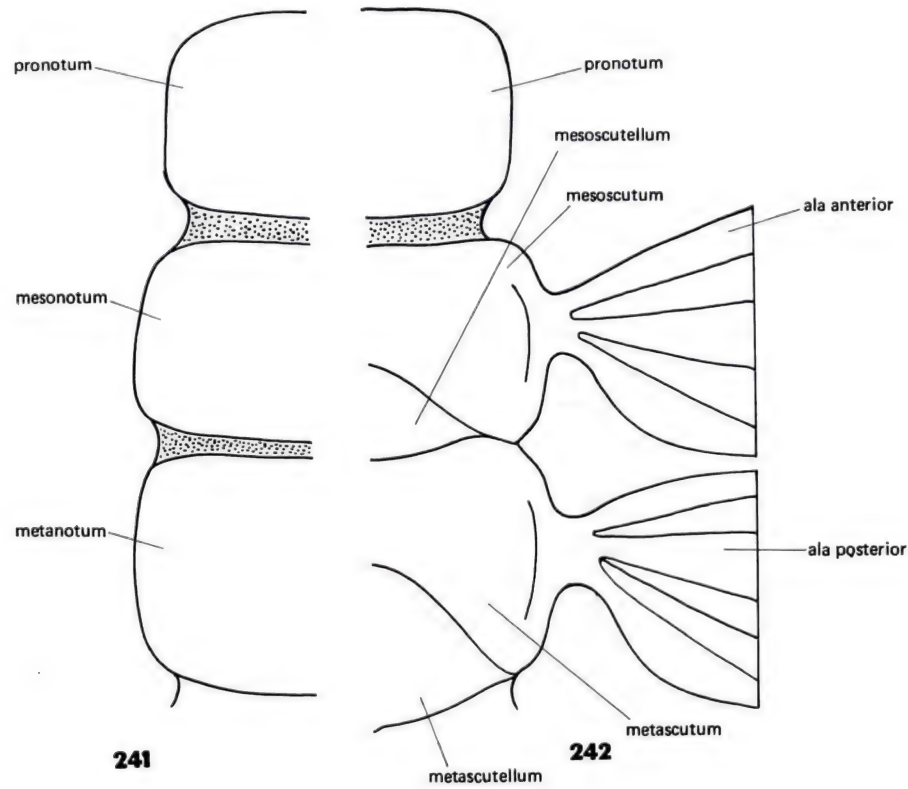
Figs. 234–235. The thorax in ventral view. — 234: Thorax and first two abdominal sternites of a Diptera, and 235: the meso- and metasternum of a Coleoptera (after Snodgrass 234, and Larsen 235)



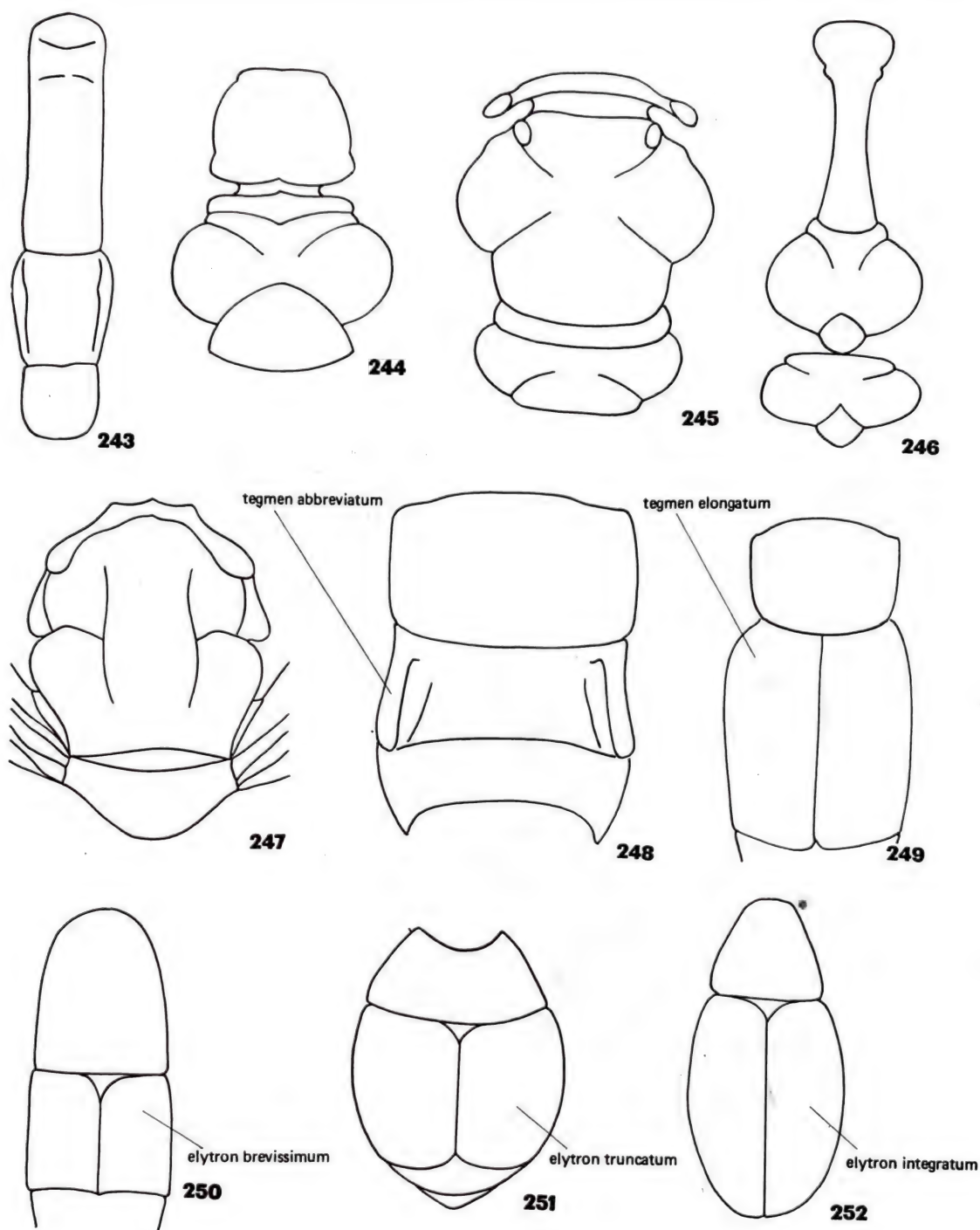
Figs. 236–238. The thorax in ventral view. — 236: Myrsidea-type (Mall.), 237: Esthiopterum-type (Mall.), and 238: Notonecta-type (Heteropt.) (after Cope 236, Mayer 237, and Matsuda 238)



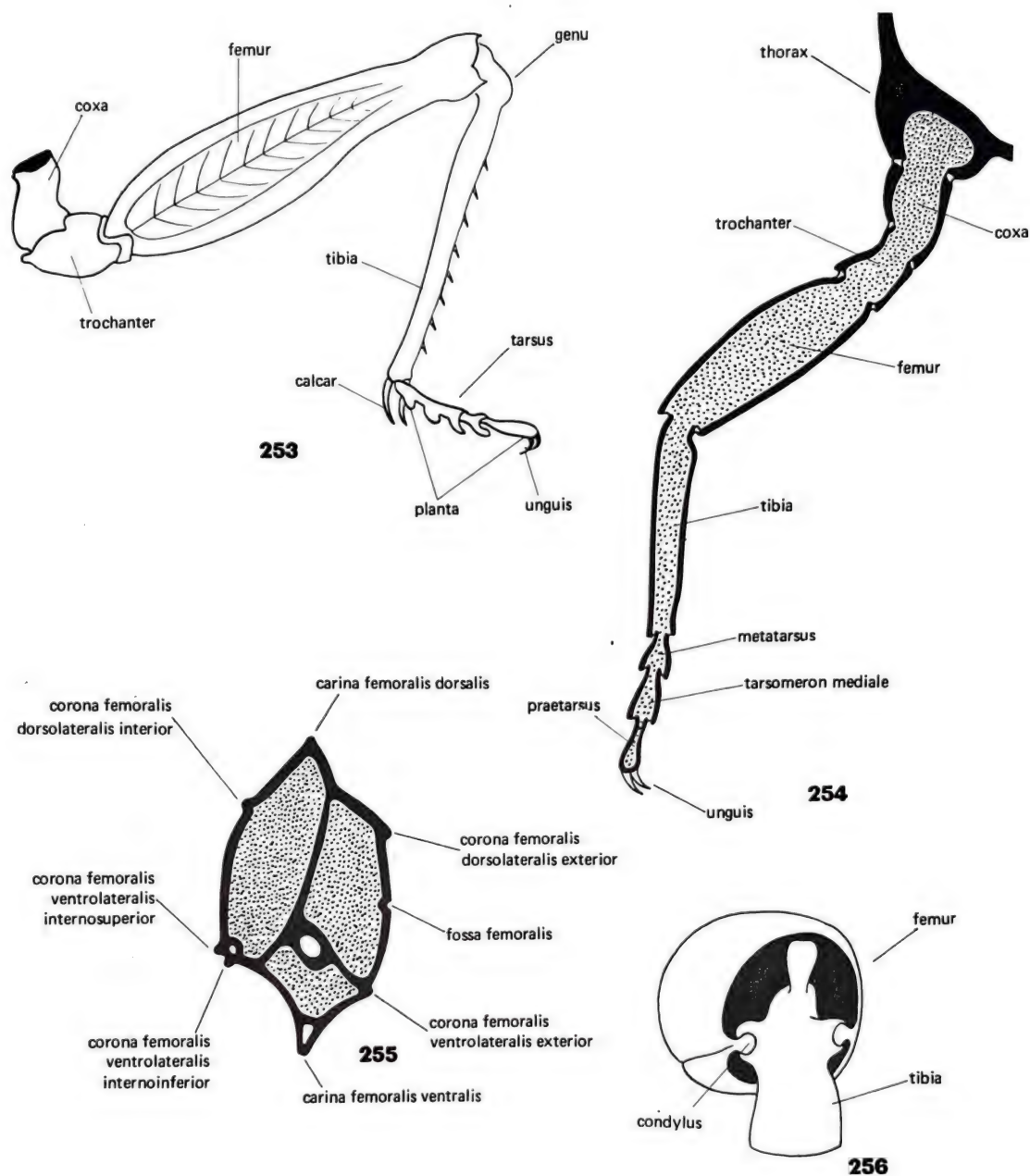
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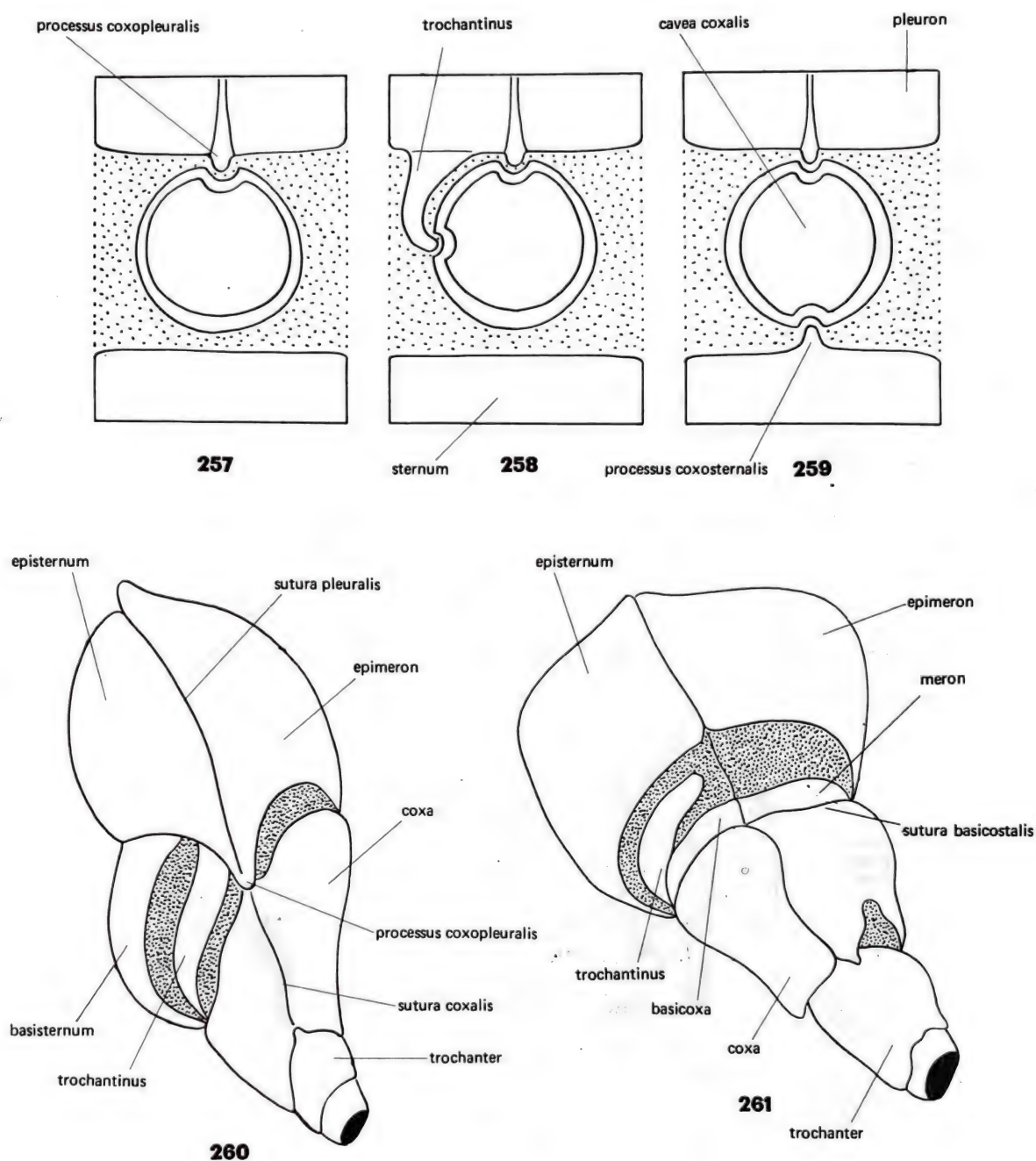
Figs. 241–242. Schematic drawing of the thorax in dorsal view. — 241: Wingless, and 242: winged



Figs. 243–252. Some typical thoraces in dorsal view. — 243: *Carausius* (Phasm.), 244: *Myrmeleon* (Neuropt.), 245: *Ascalaphus* (Neuropt.), 246: *Mantispa* (Neuropt.), 247: *Tabanus* (Dipt.), 248: *Anisolabis* (Dermapt.), 249: *Labidura* (Dermapt.), 250: *Staphilinus* (Coleopt.), 251: *Hister* (Coleopt.), and 252: *Brachonyx* (Coleopt.)



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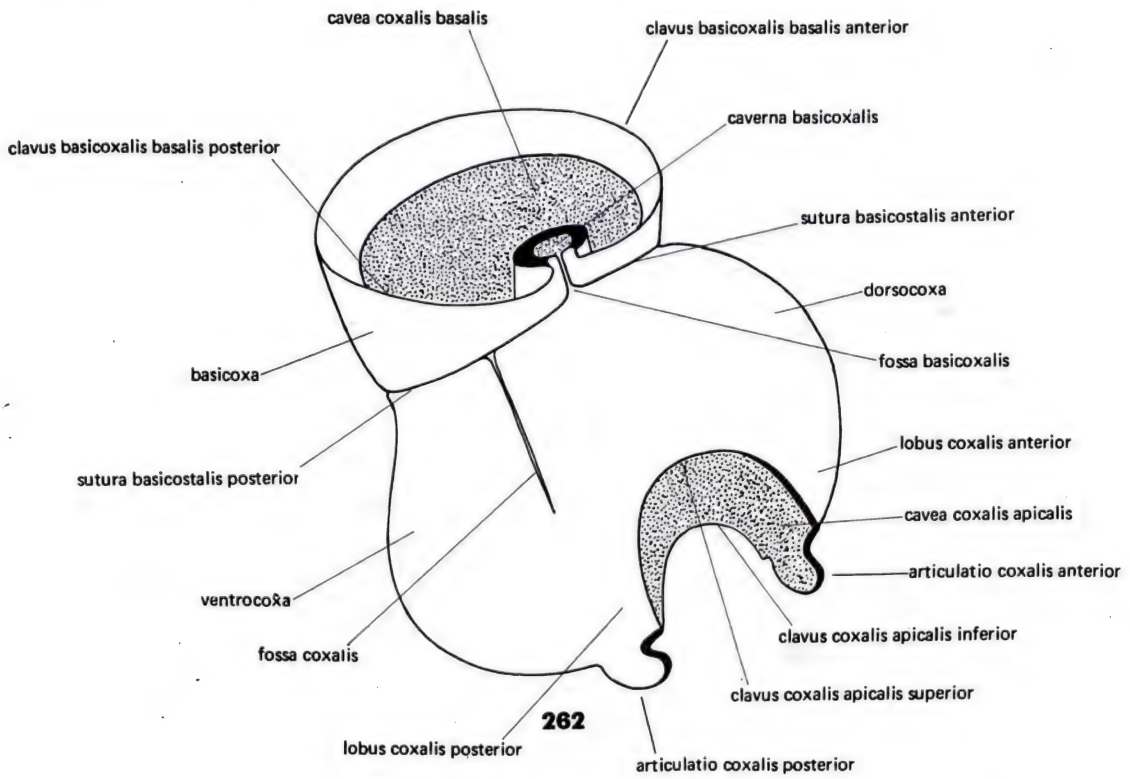


Fig. 262. The fixed coxa (coxa fixa)

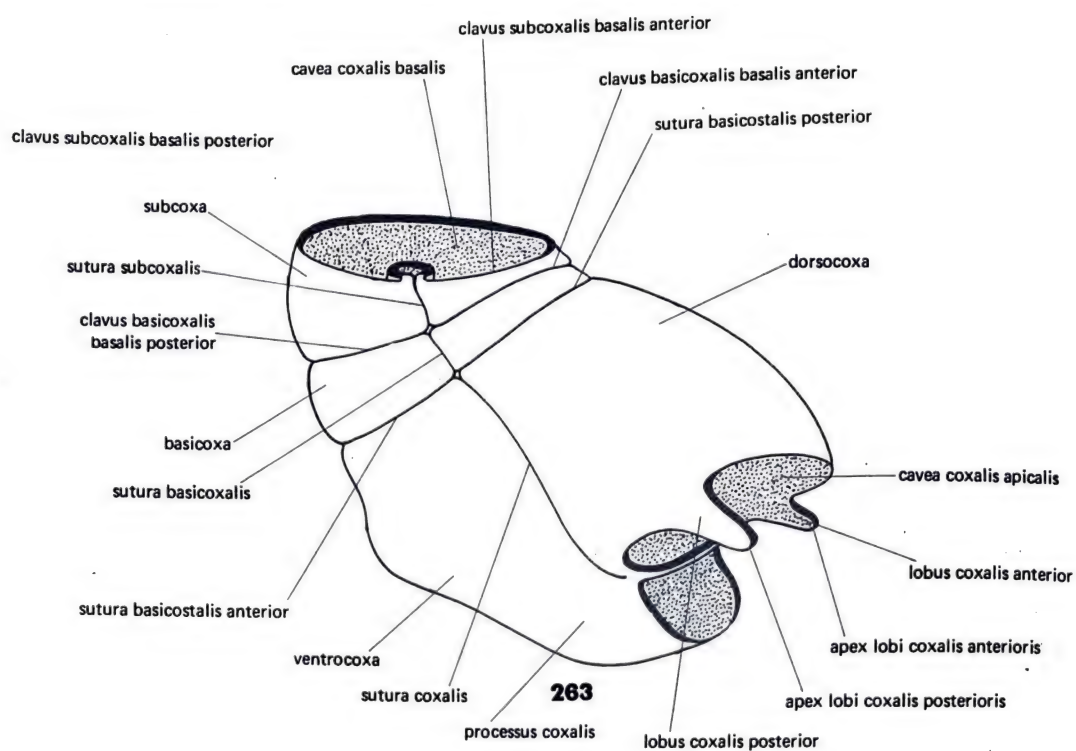
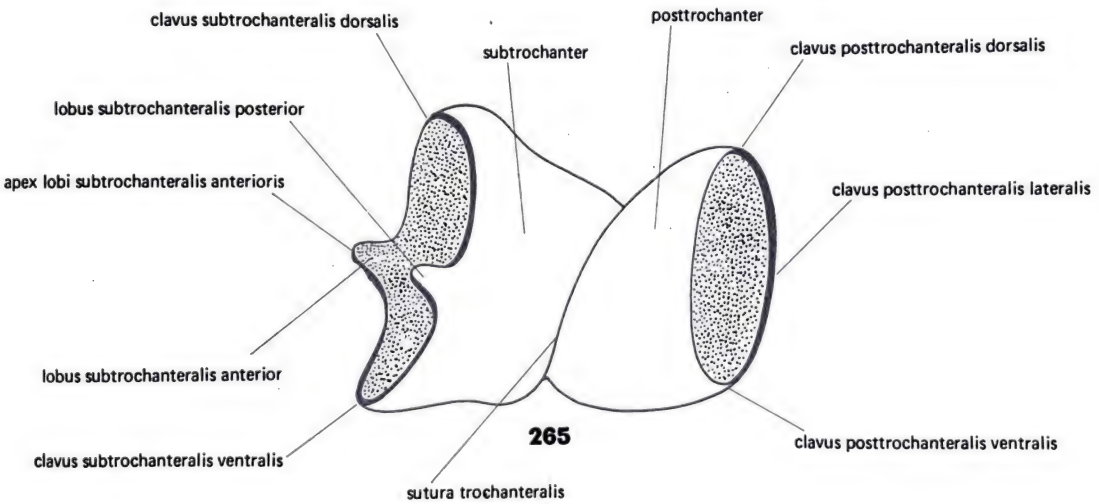
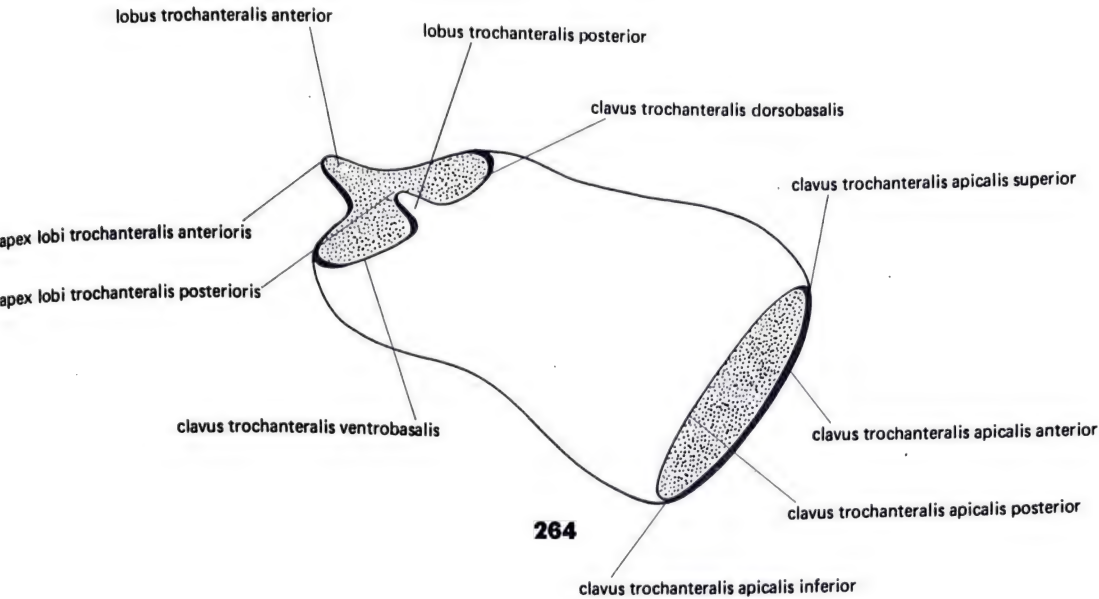


Fig. 263. The free coxa (coxa libera)



Figs. 264–265. The trochanter. — 264: Simple trochanter (trochanter simplex), 265: subtrochanter and posttrochanter (trochanter compositus)

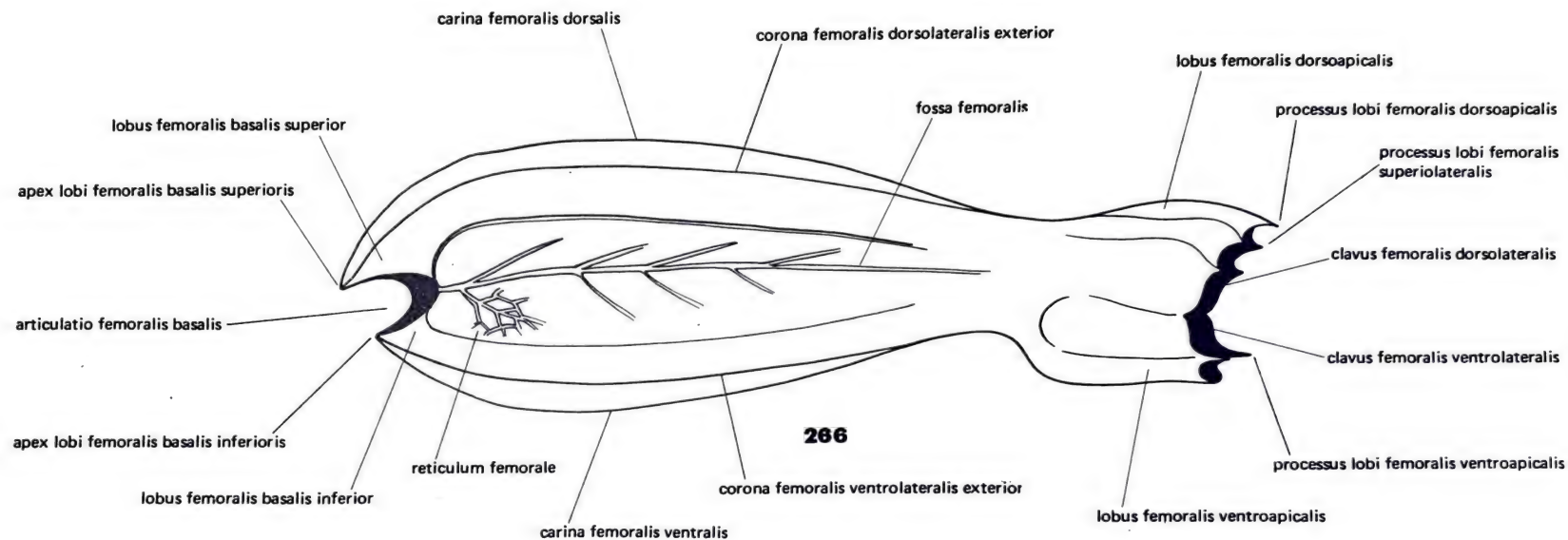


Fig. 266. The femur

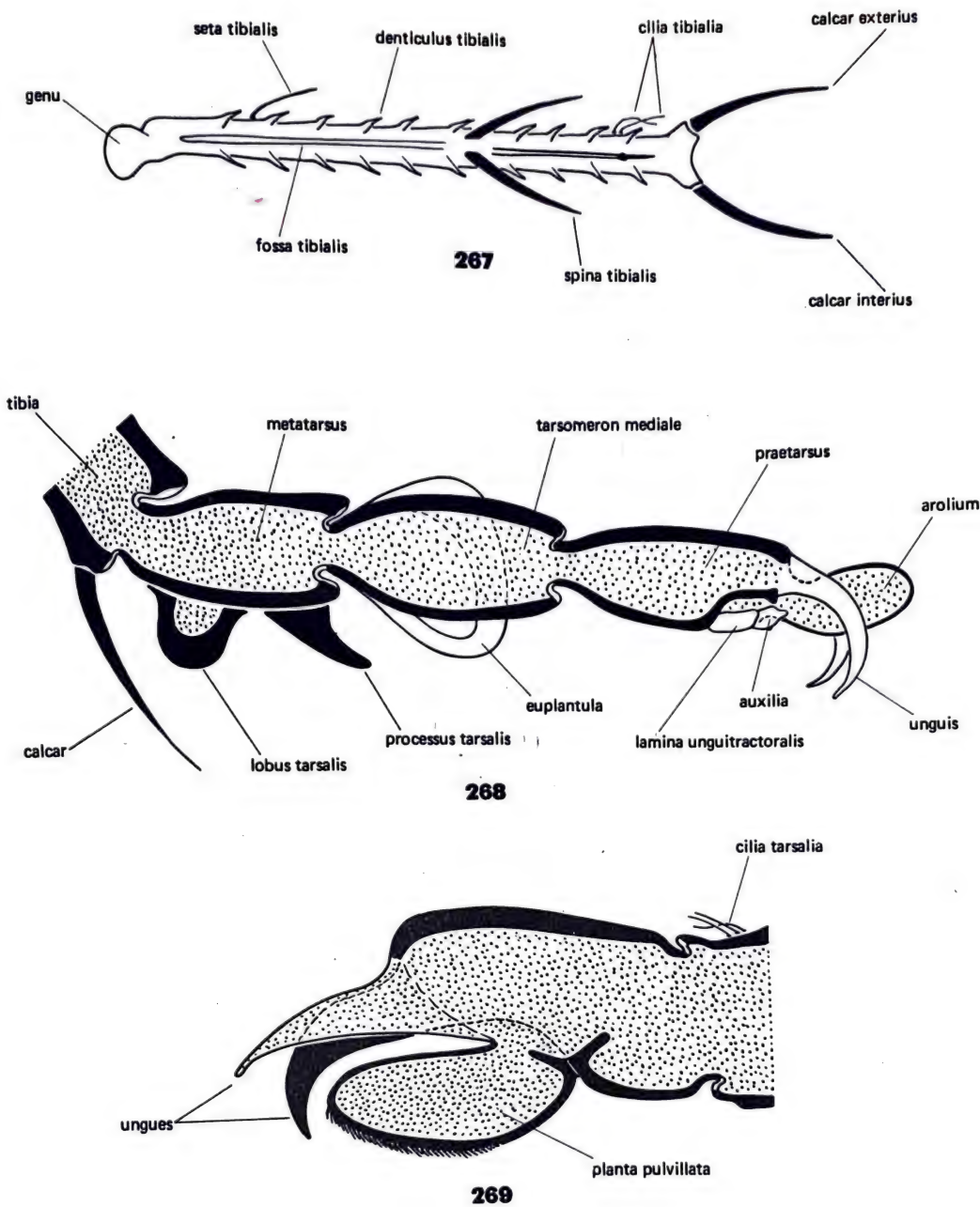
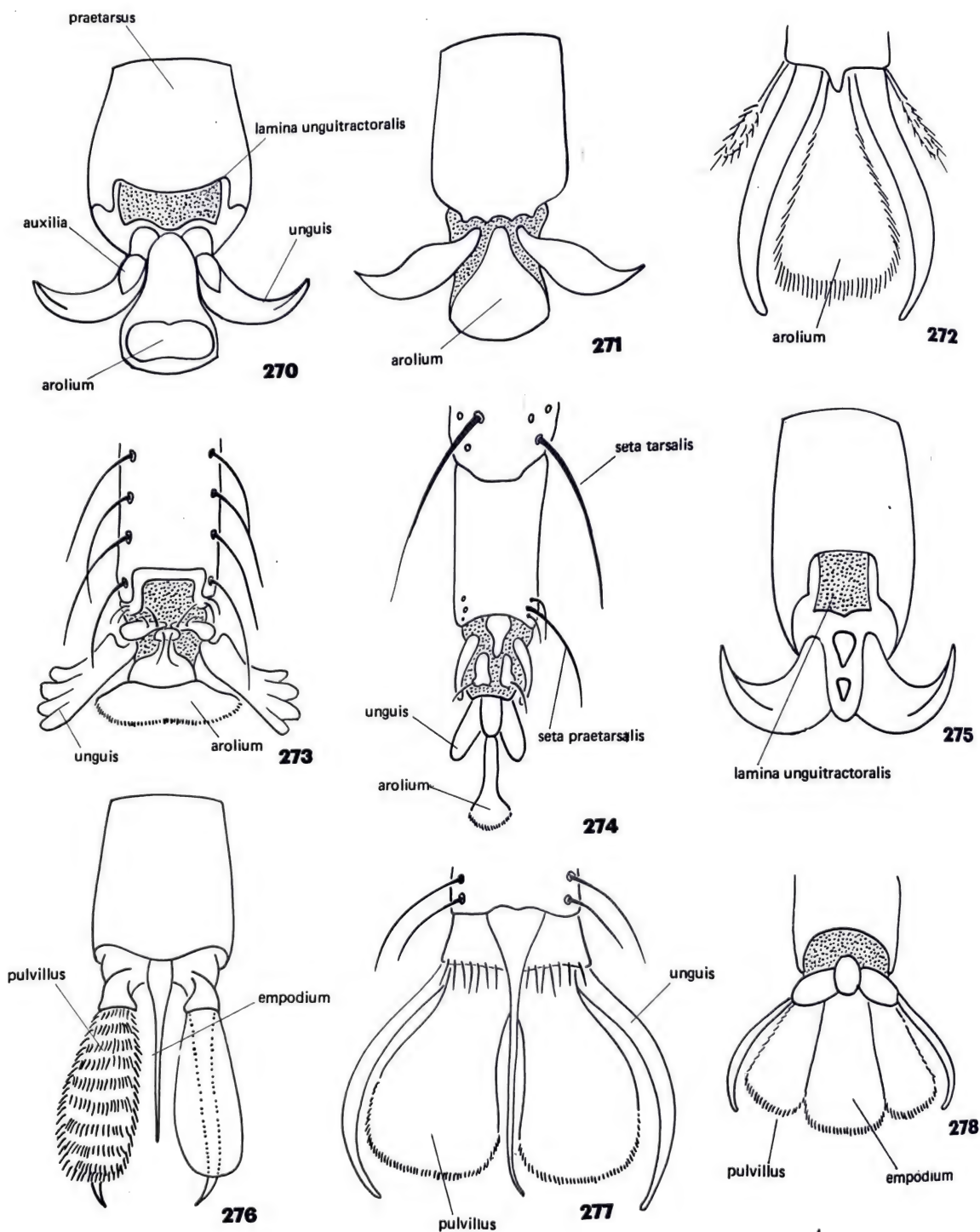
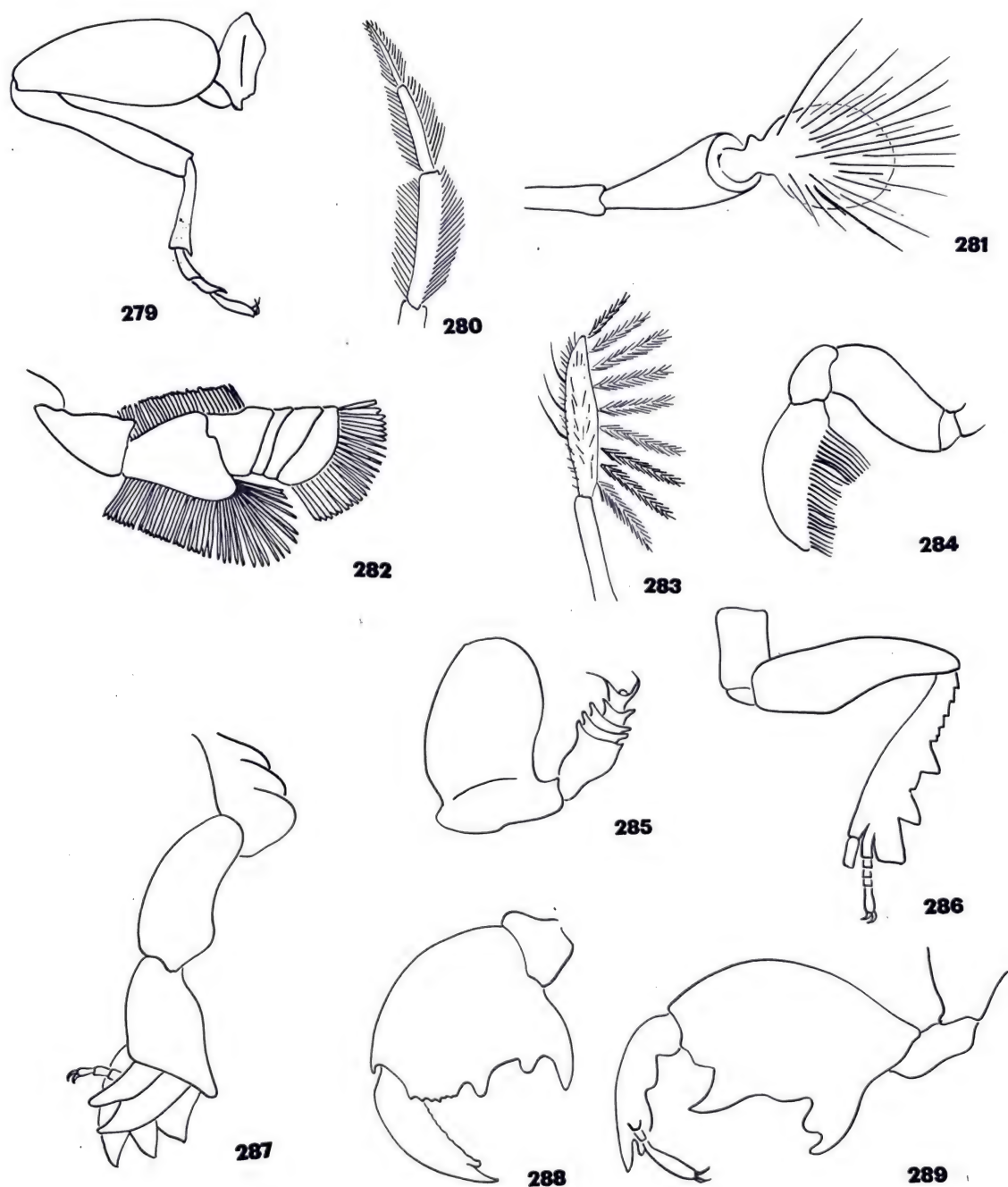


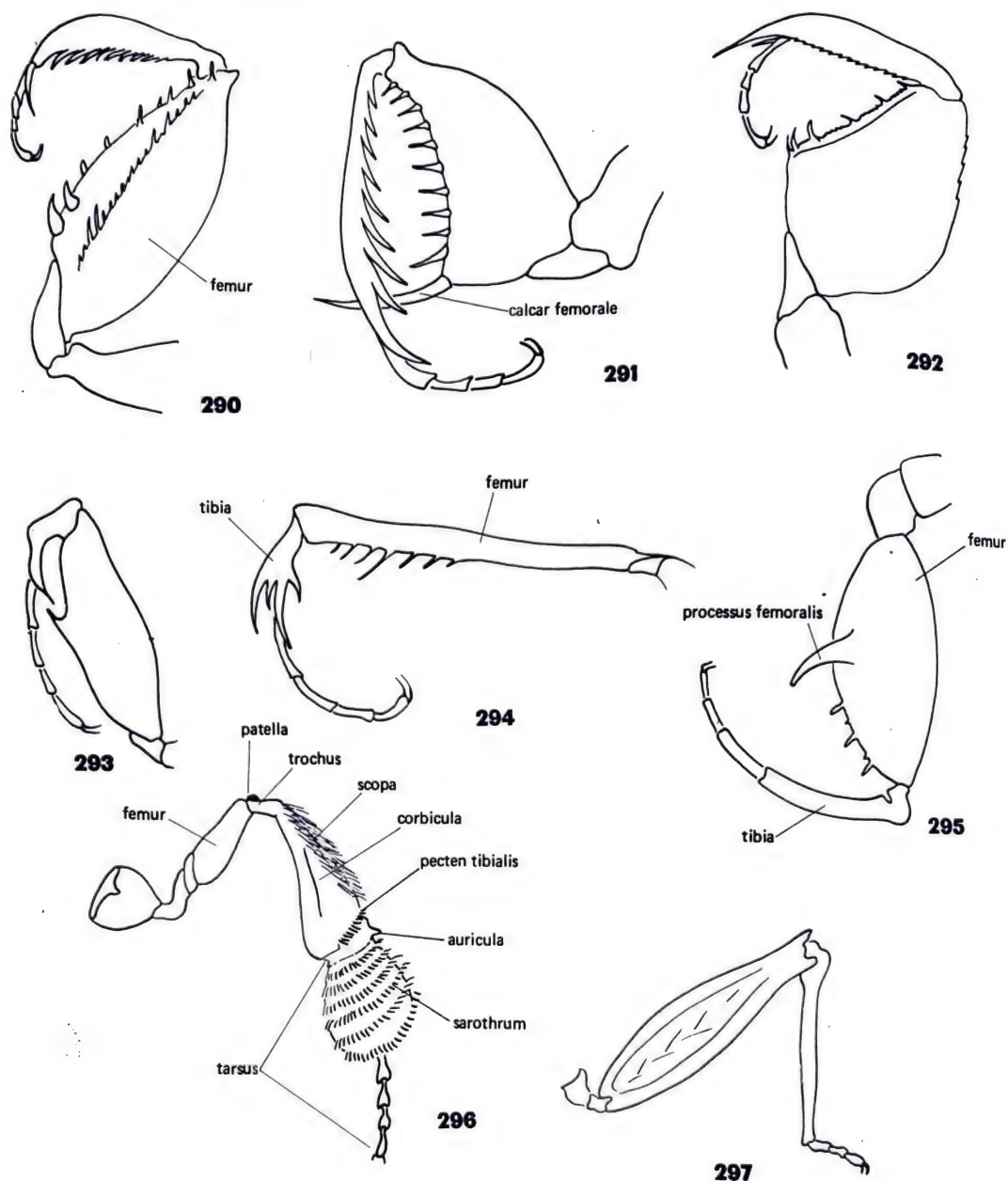
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Figs. 279–289. Some important types of the leg. — 279: Walking leg (*Chrysomela*, Coleopt.), 280–284: swimming leg, 280: *Notonecta* (Heteropt.), 281: *Deuterophlebia* (Dipt.), 282: *Gyrinus* (Coleopt.), 283: *Rhagovelia* (Heteropt.), and 284: *Corixa* (Heteropt.). 285–289: Digging leg, 285: *Gryllotalpa* (Orthopt.), 286: *Vespa* (Hymenopt.), 287: *Canthon* (Coleopt.), 288: *Magiciada* (Homopt.) (frontal), and 289: same (lateral) (after Shvanvich 279–284, 289, and Snodgrass 285–288)



Figs. 290–297. Some important types of the leg. — 290–295: Predatory leg, 290: *Eremiaphilla* (Mant.), 291: *Metallytims* (Mant.), 292: *Acanthomantis* (Mant.), 293: *Amorphoscelis* (Mant.), 294: *Thespotia* (Mant.), and 295: *Mantispa* (Neuropt.). 296: Gathering leg (*Apis*, Hymenopt.). 297: Jumping leg (*Omocestus*, Orthopt.) (Beier 290–295, Shvanvich 296)

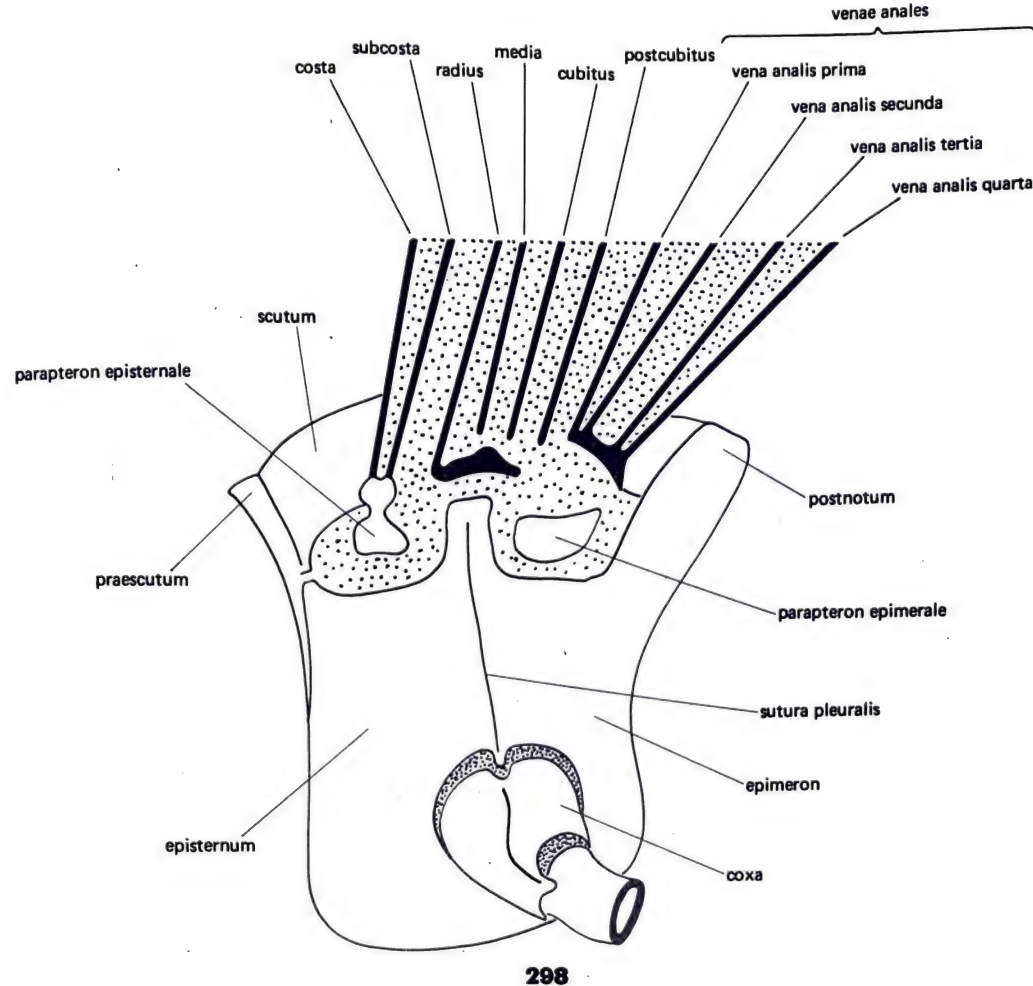
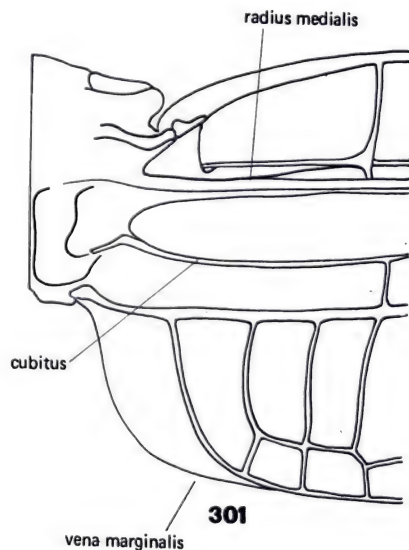
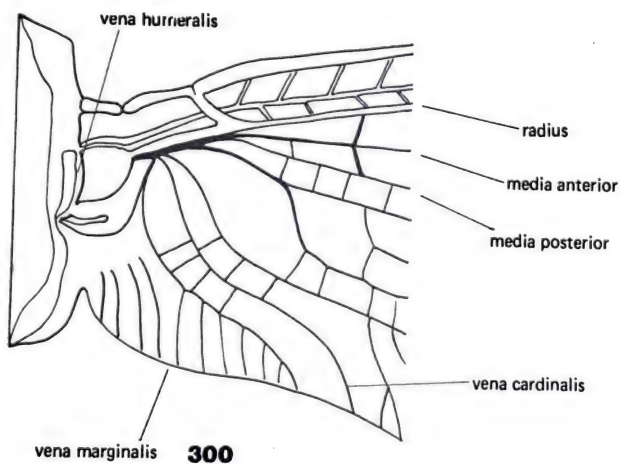
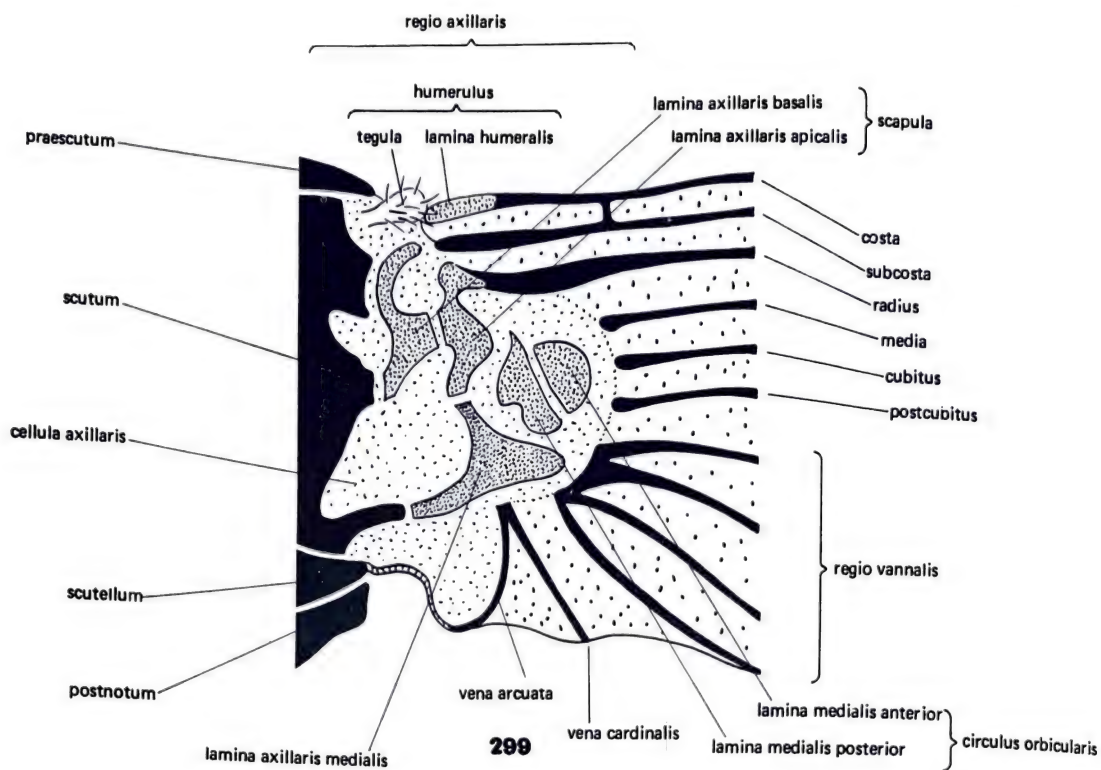
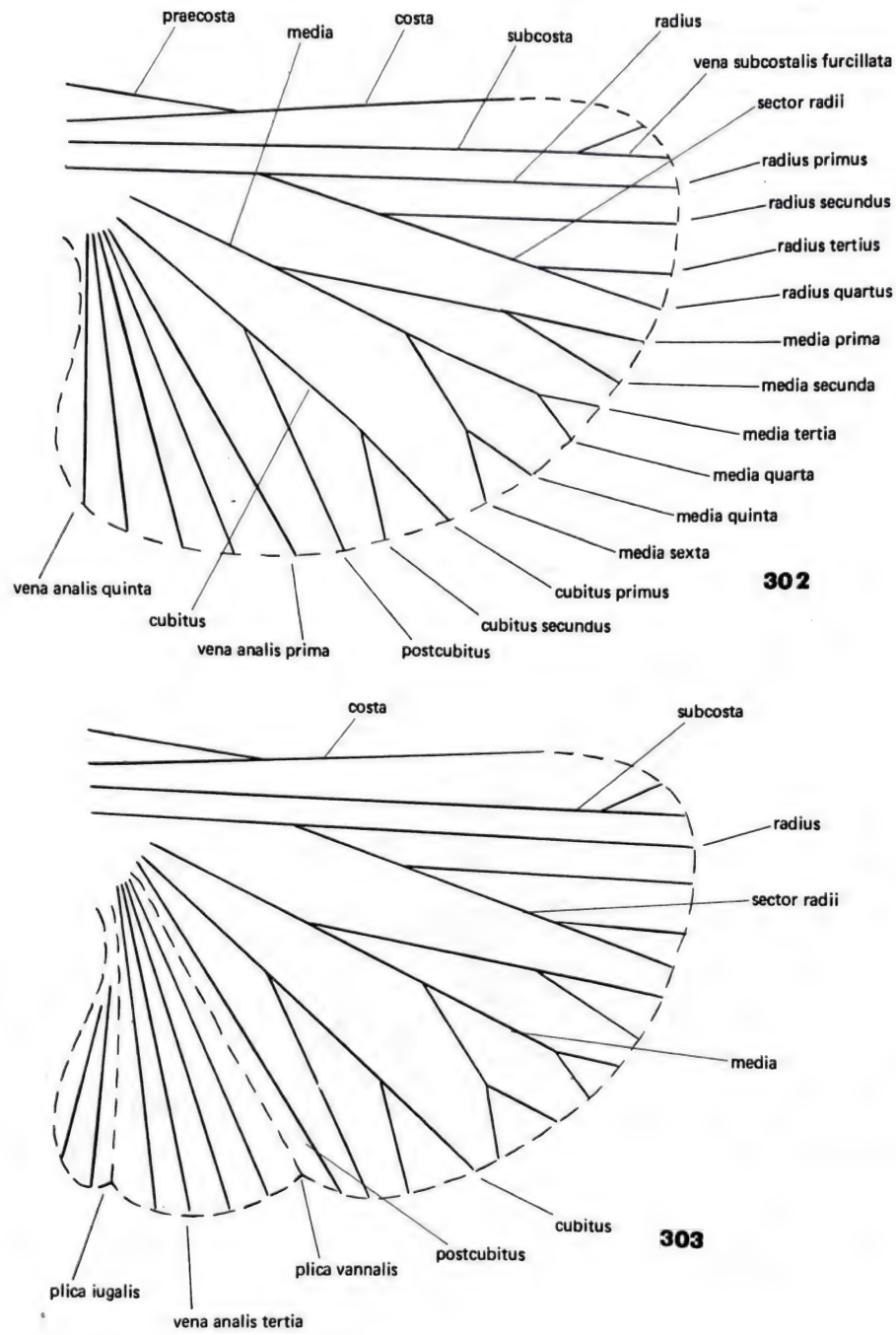


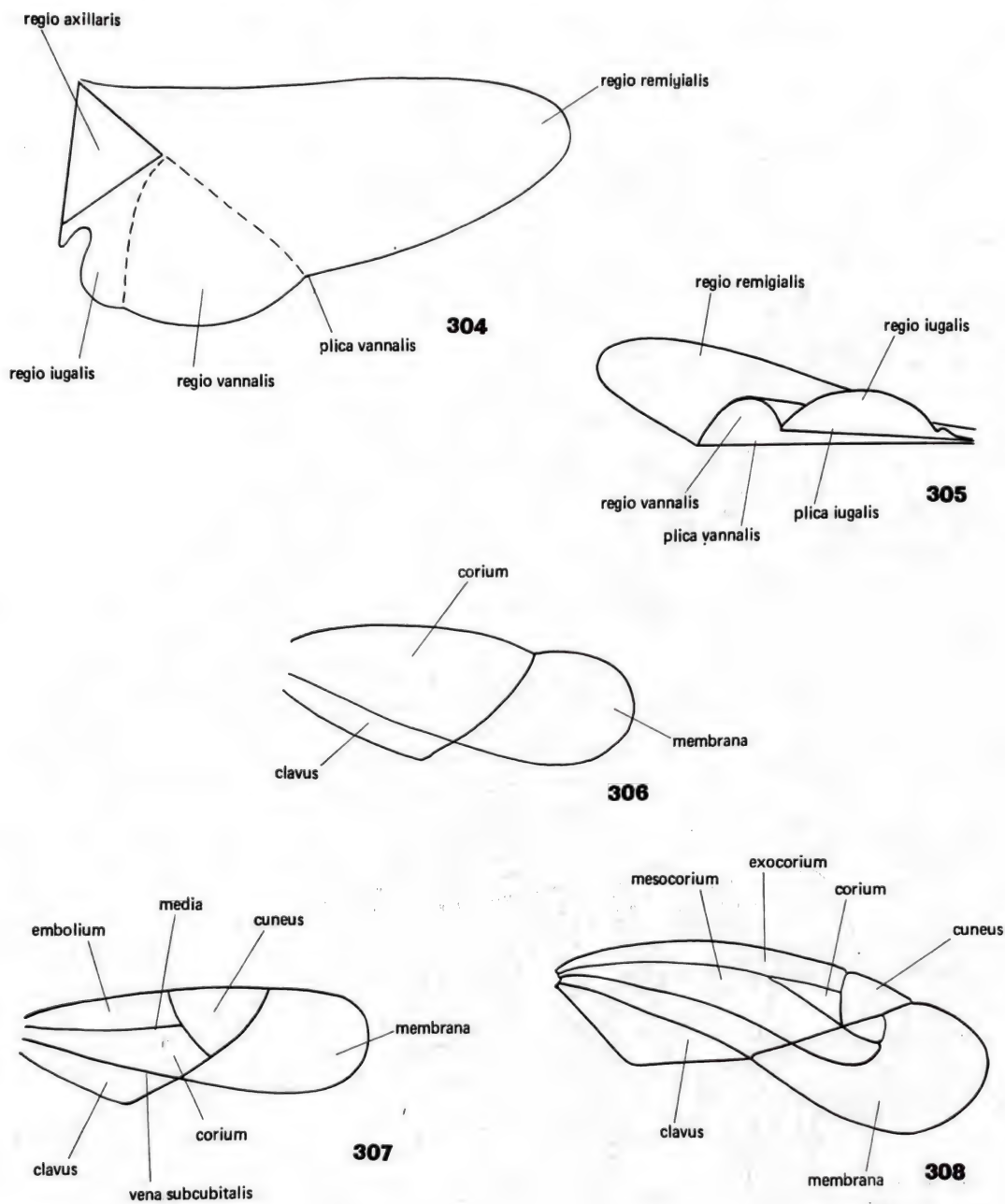
Fig. 298. Schematic drawing of the base of the wing with thoracic segment (in lateral view)



Figs. 299–301. Schematic drawing of the base of the wing. – 299: With the axillary region (regio axillaris). 300: Fore wing, and 301: hind wing (after Seidel and Eidmann 299, and Snodgrass 300–301)



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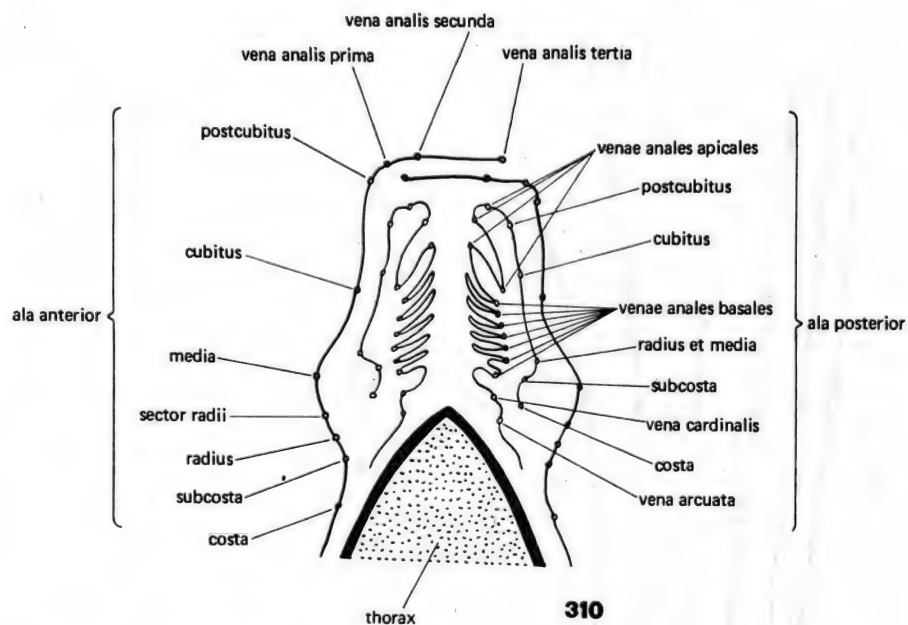
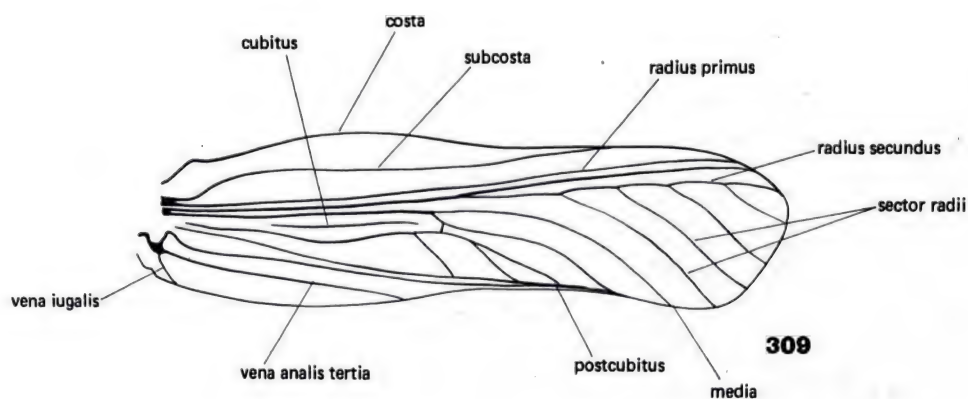


Fig. 309. The fore wing (tegmen) of the Orthoptera. — 310. Schematic drawing of the fore and hind wings of the Orthoptera in cross-section (after Snodgrass)

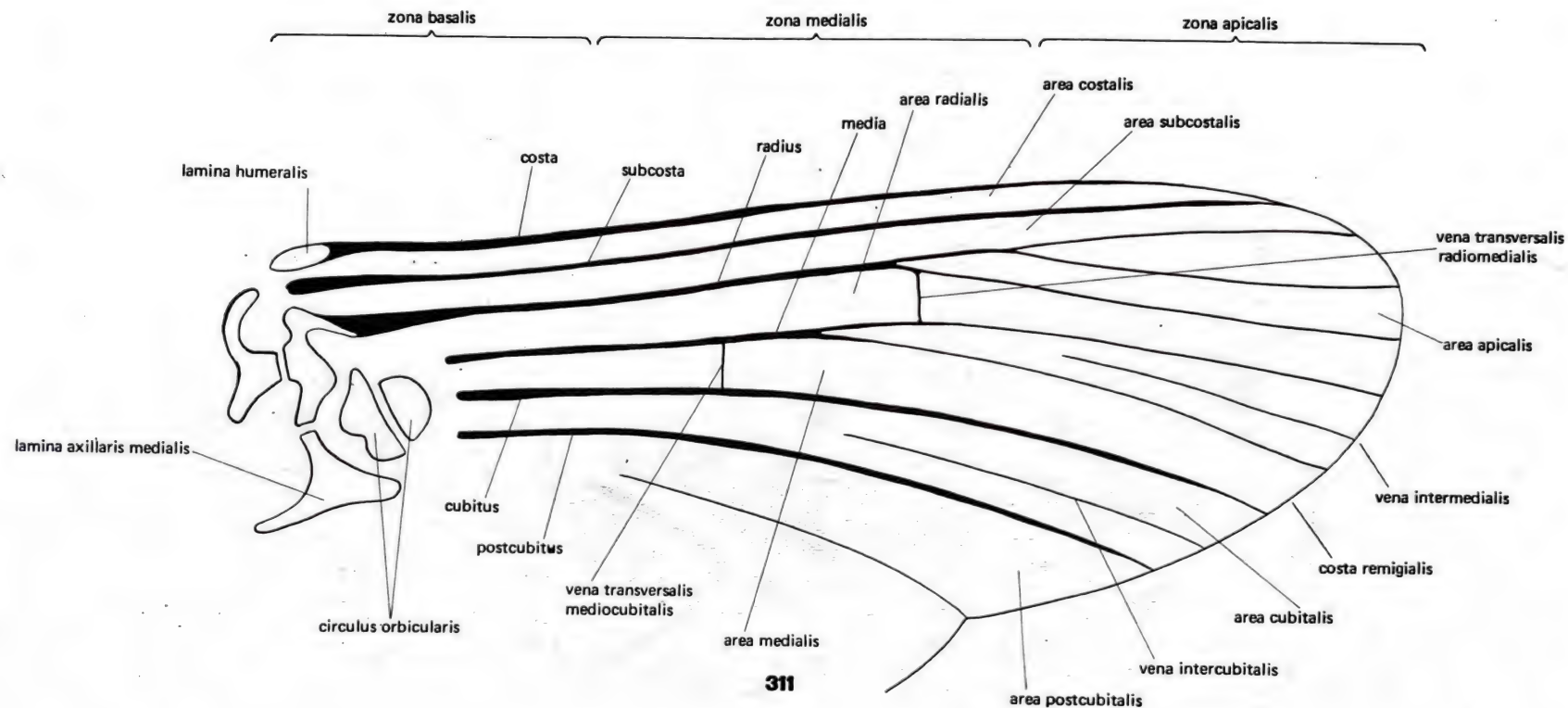


Fig. 311. The remigial region (regio remigialis)

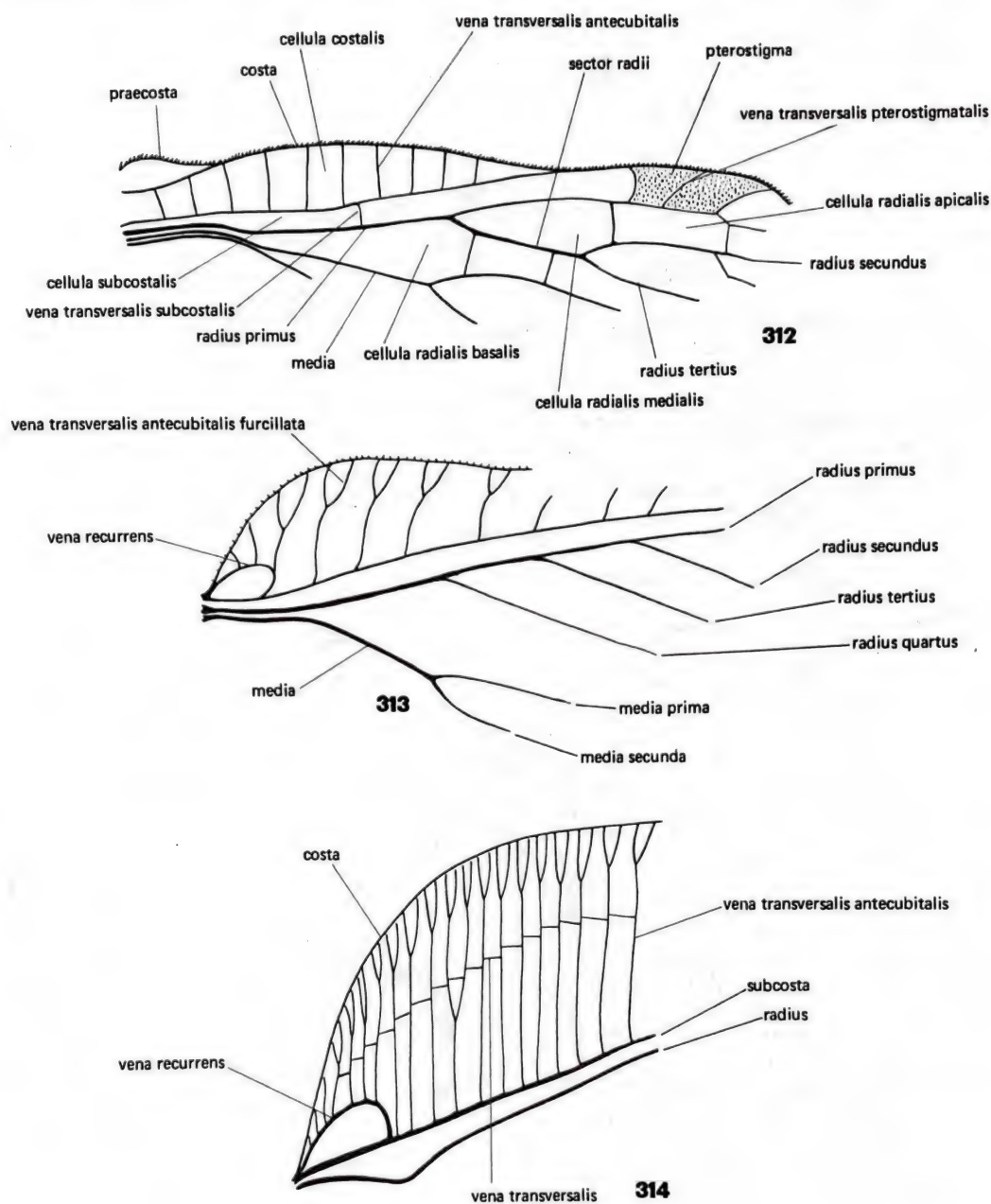


Fig. 312. The subcostal area (area subcostalis) of the Raphidia (Raphidiopt.) – 313. The radial area (area radialis) of the Megalomus (Neuropt.). – 314. The costal area (area costalis) of the Drepanopteryx (Neuropt.)

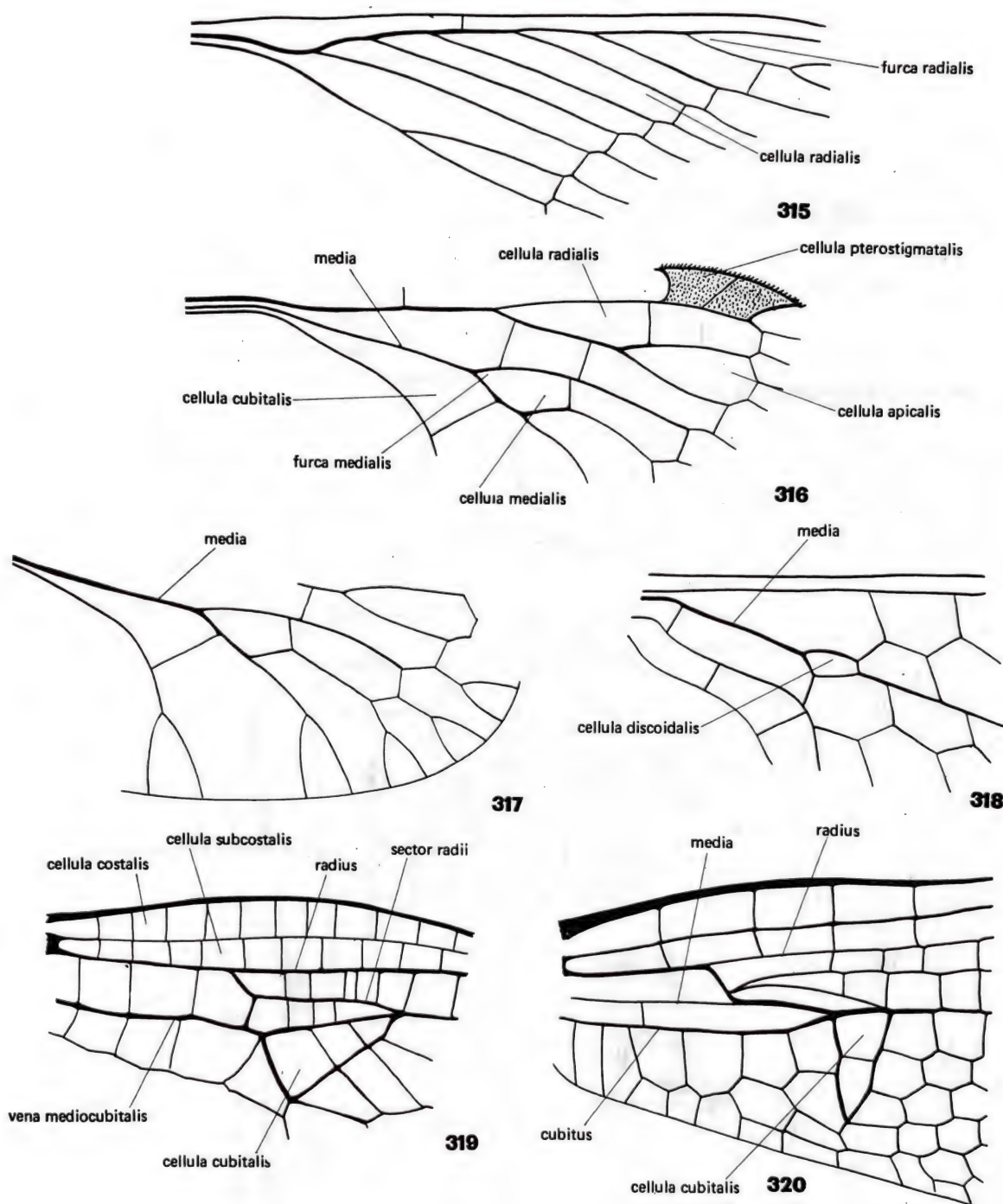
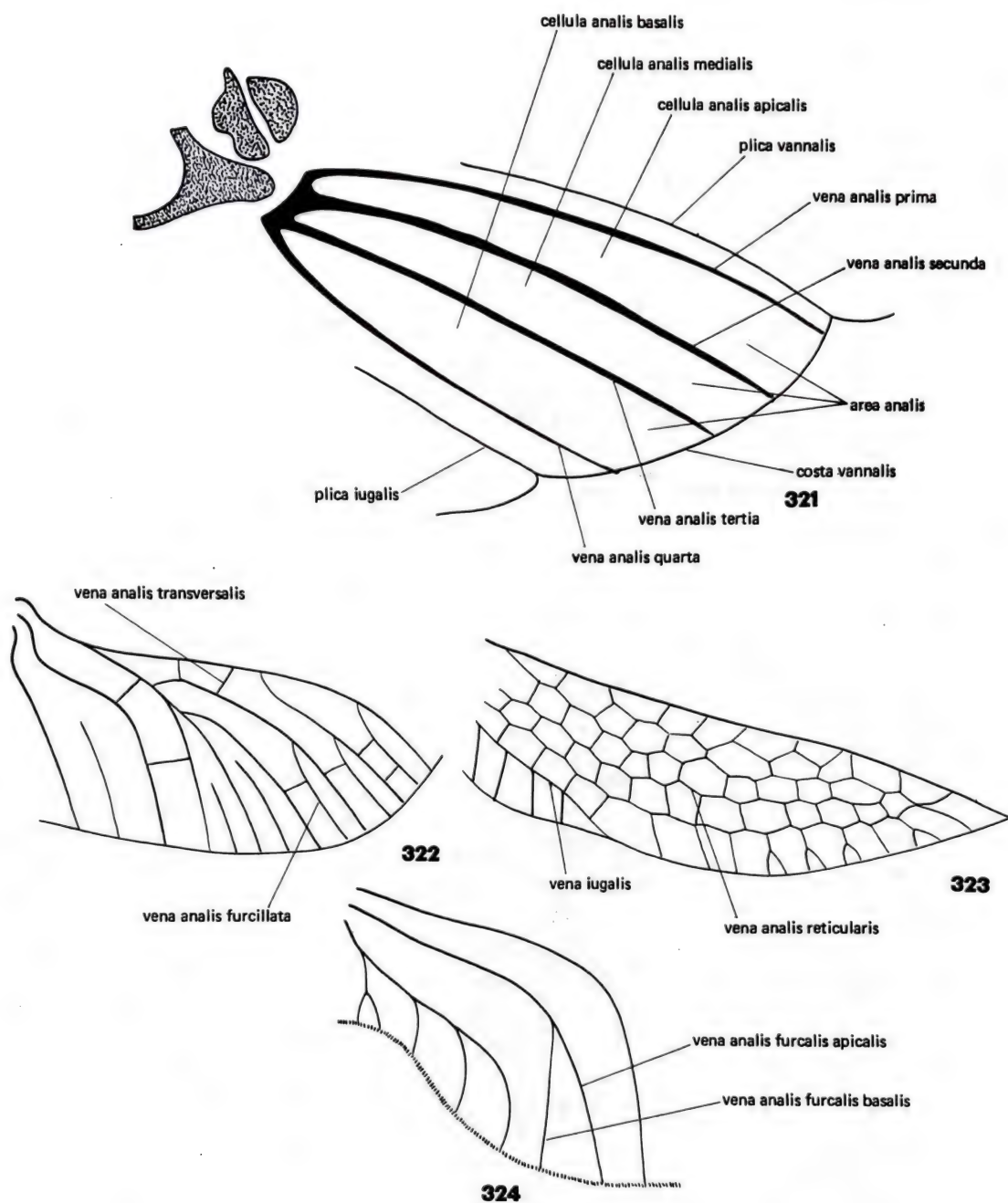
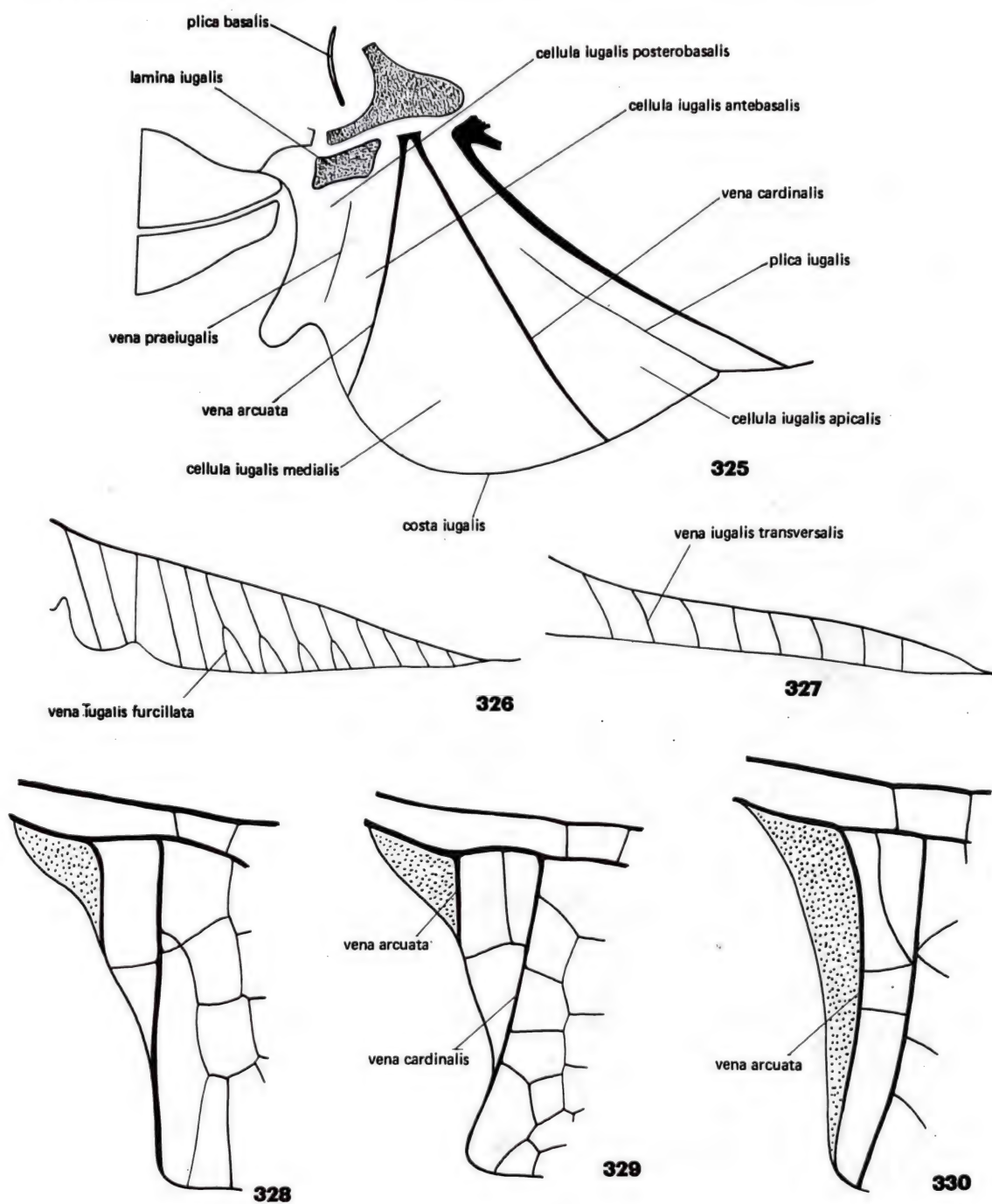


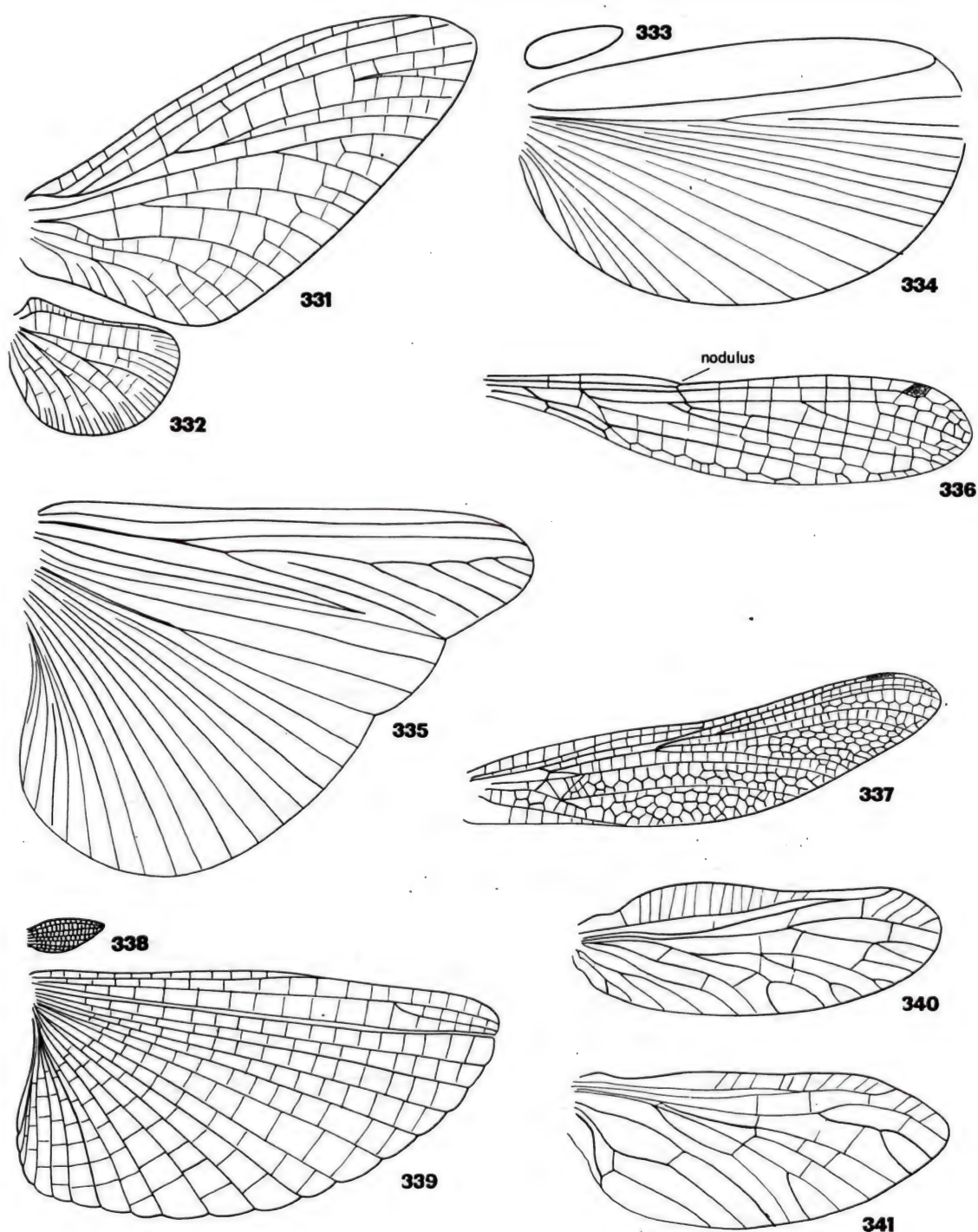
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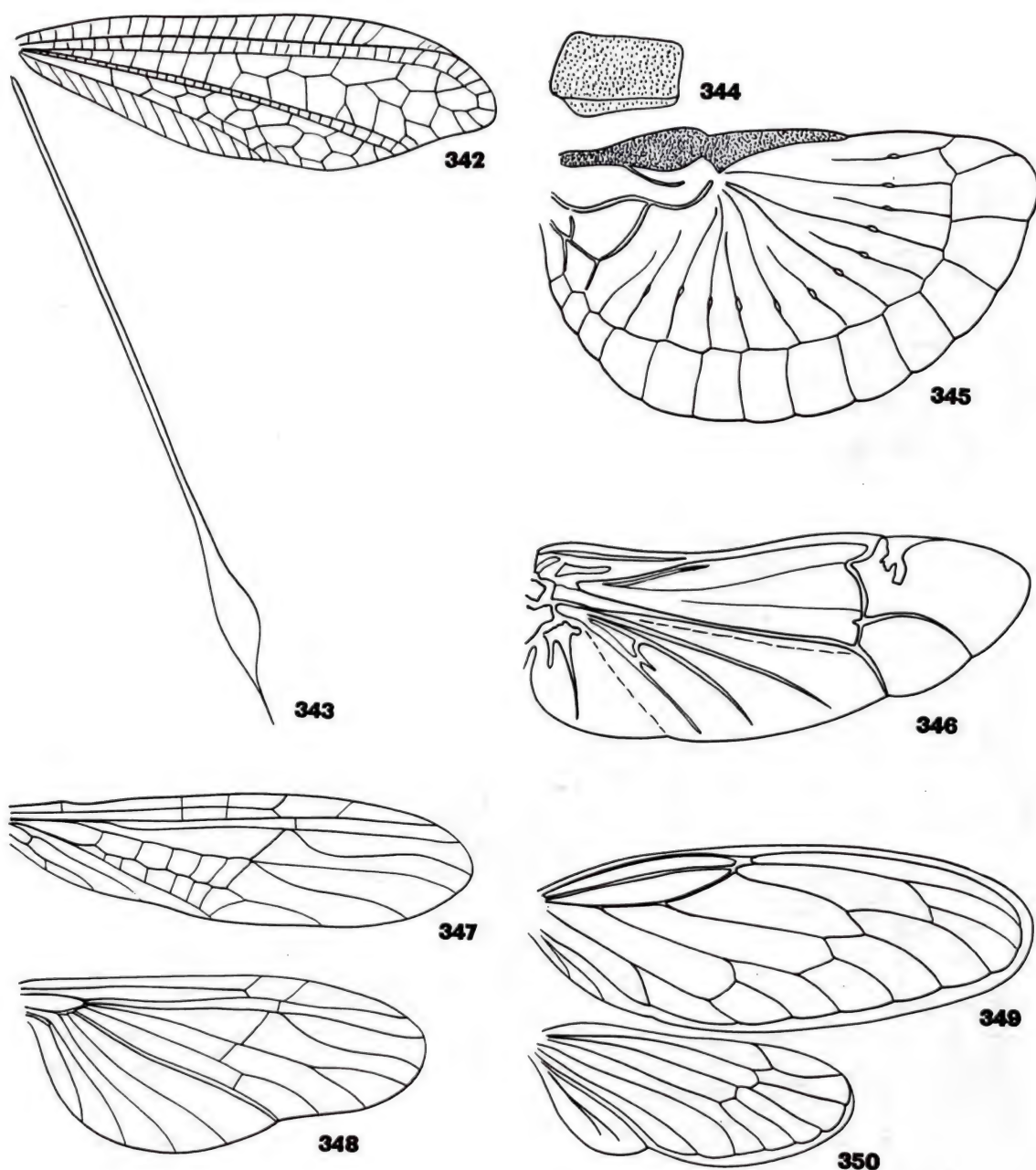
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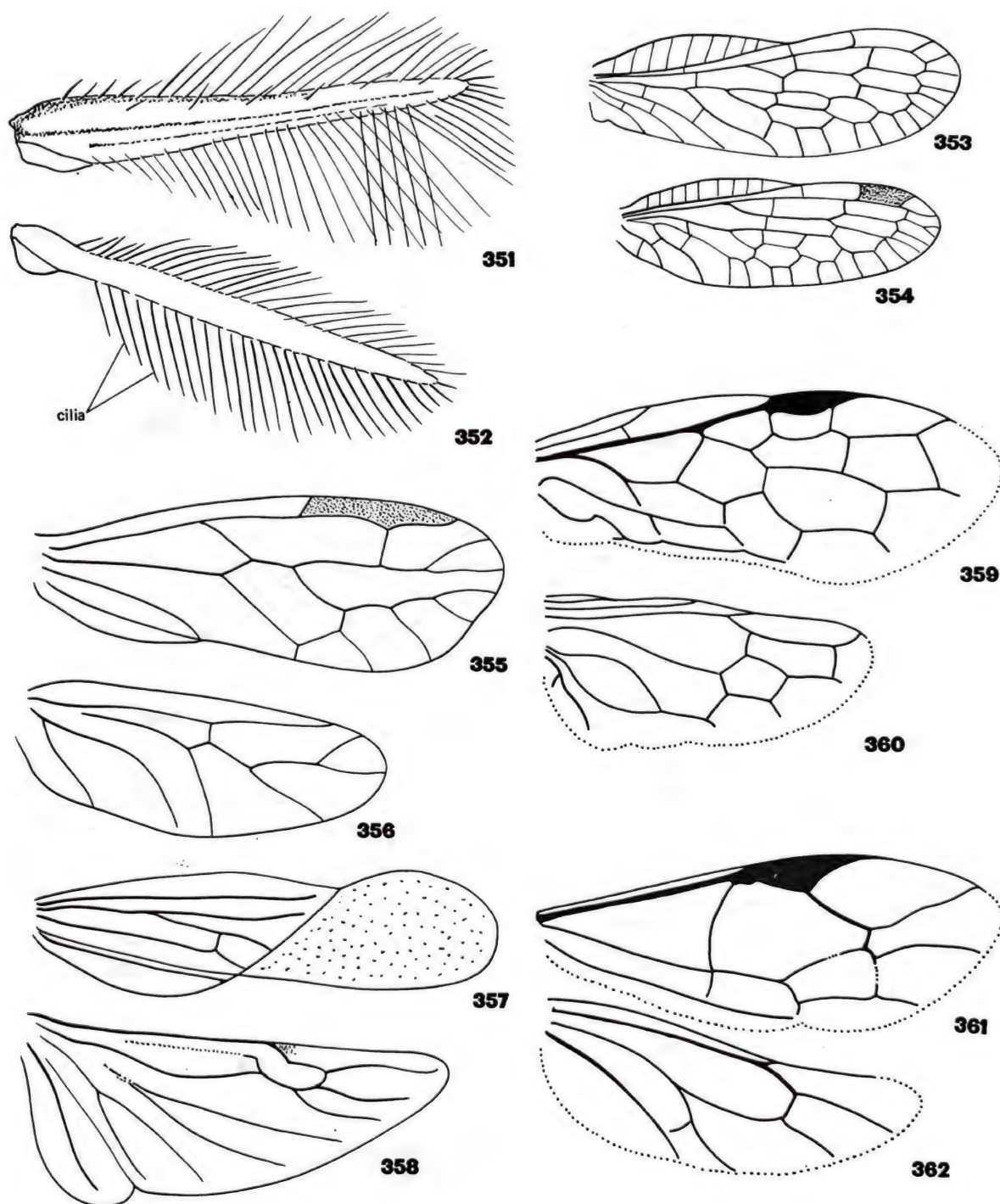
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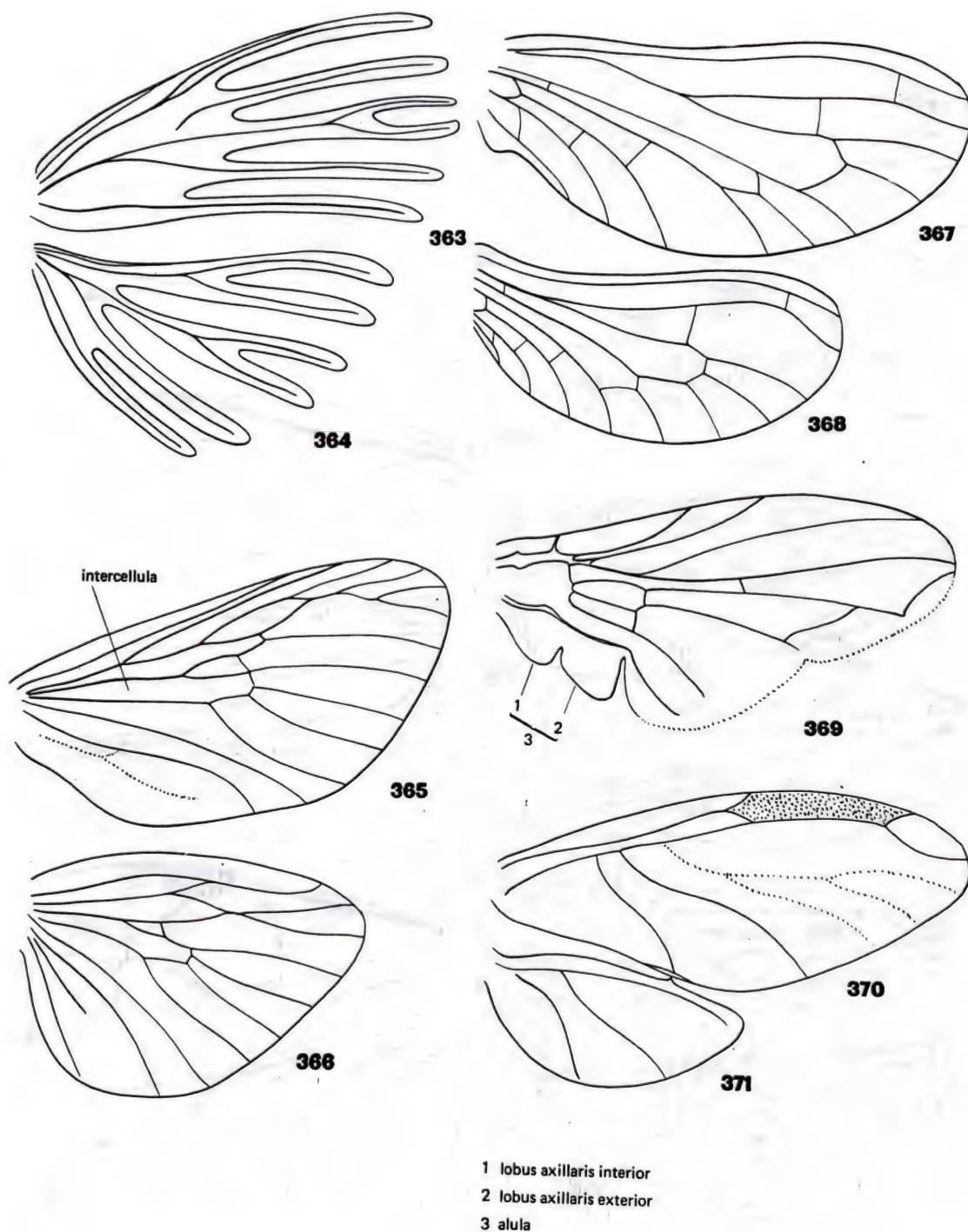
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THE ABDOMEN

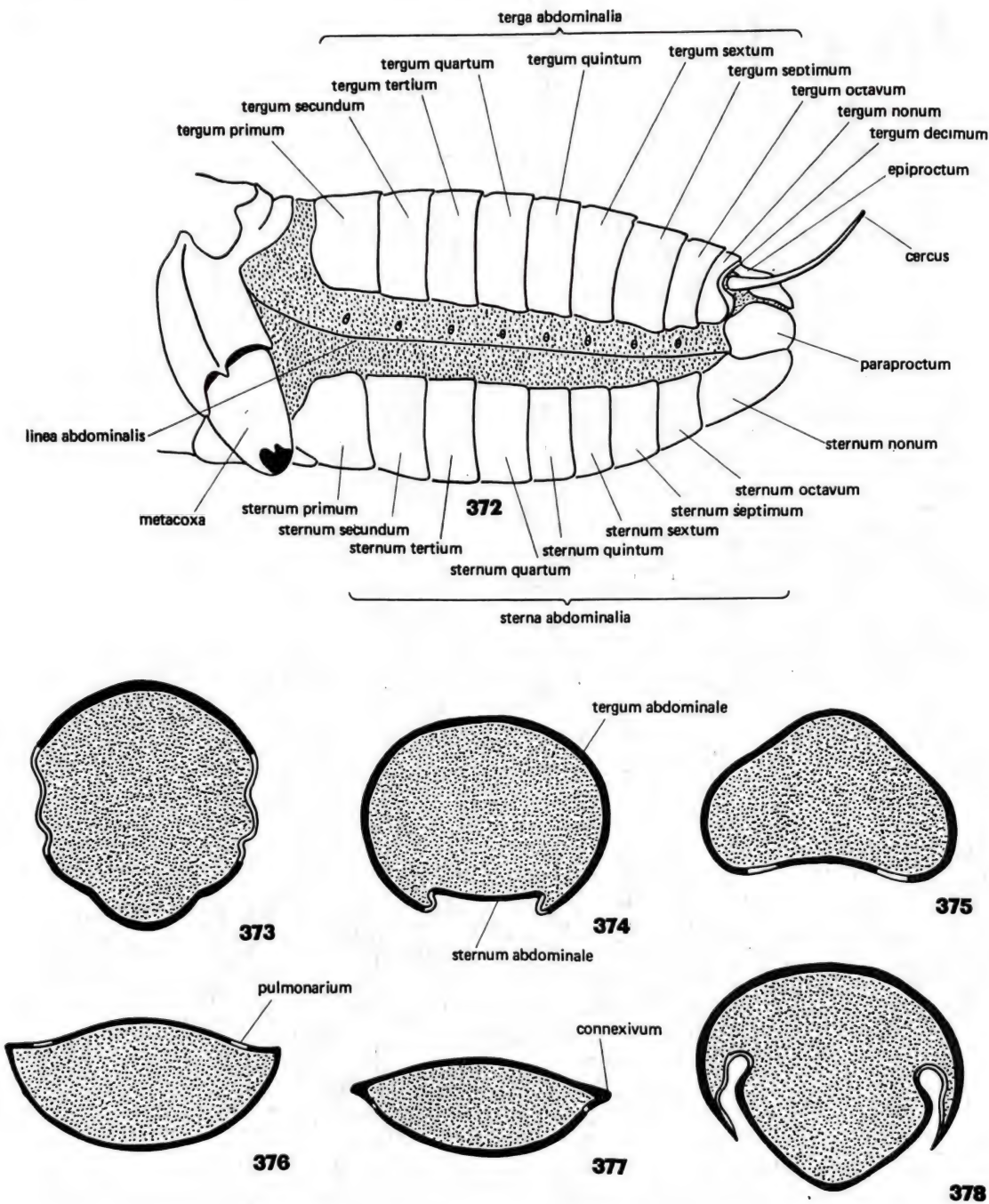
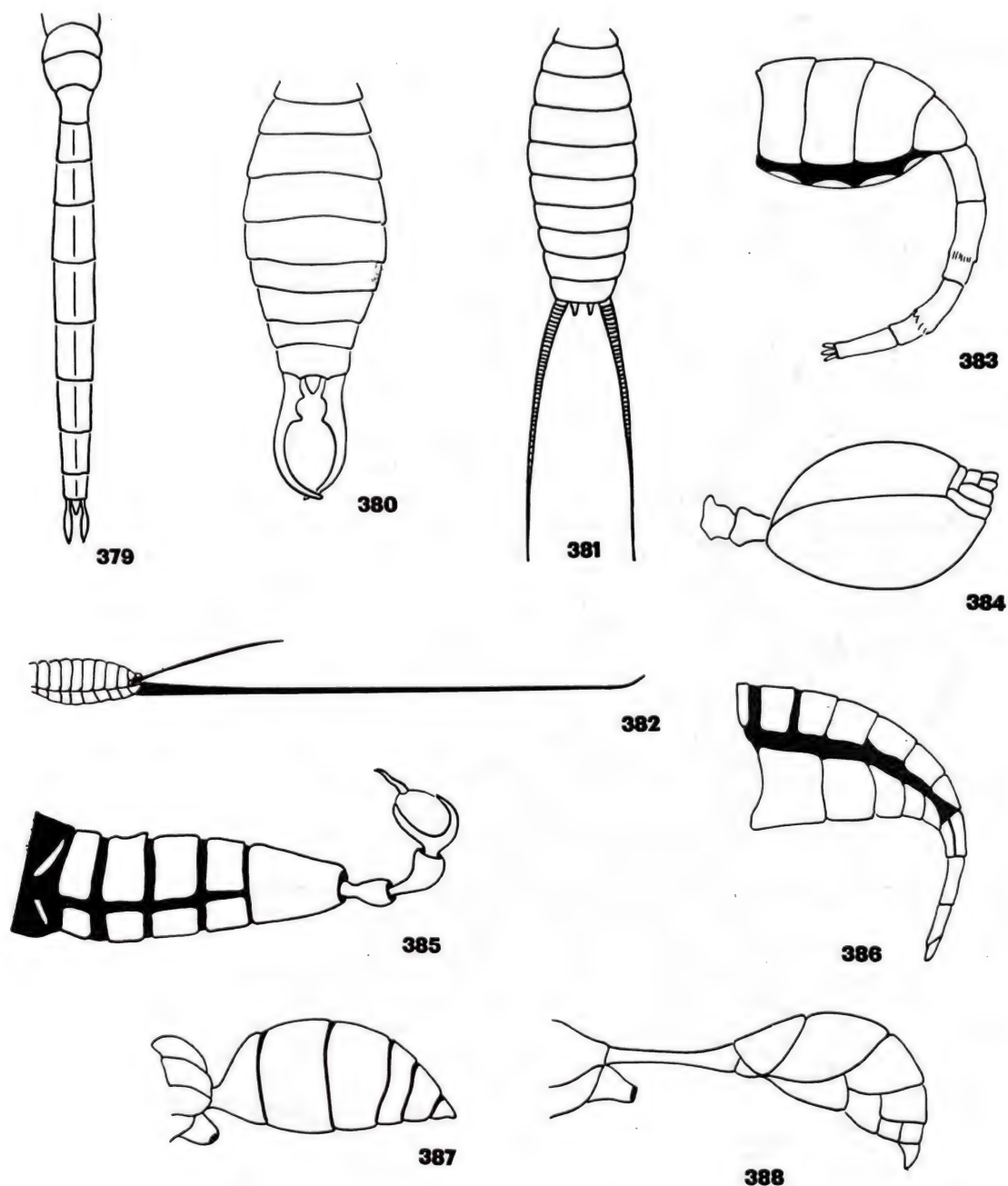
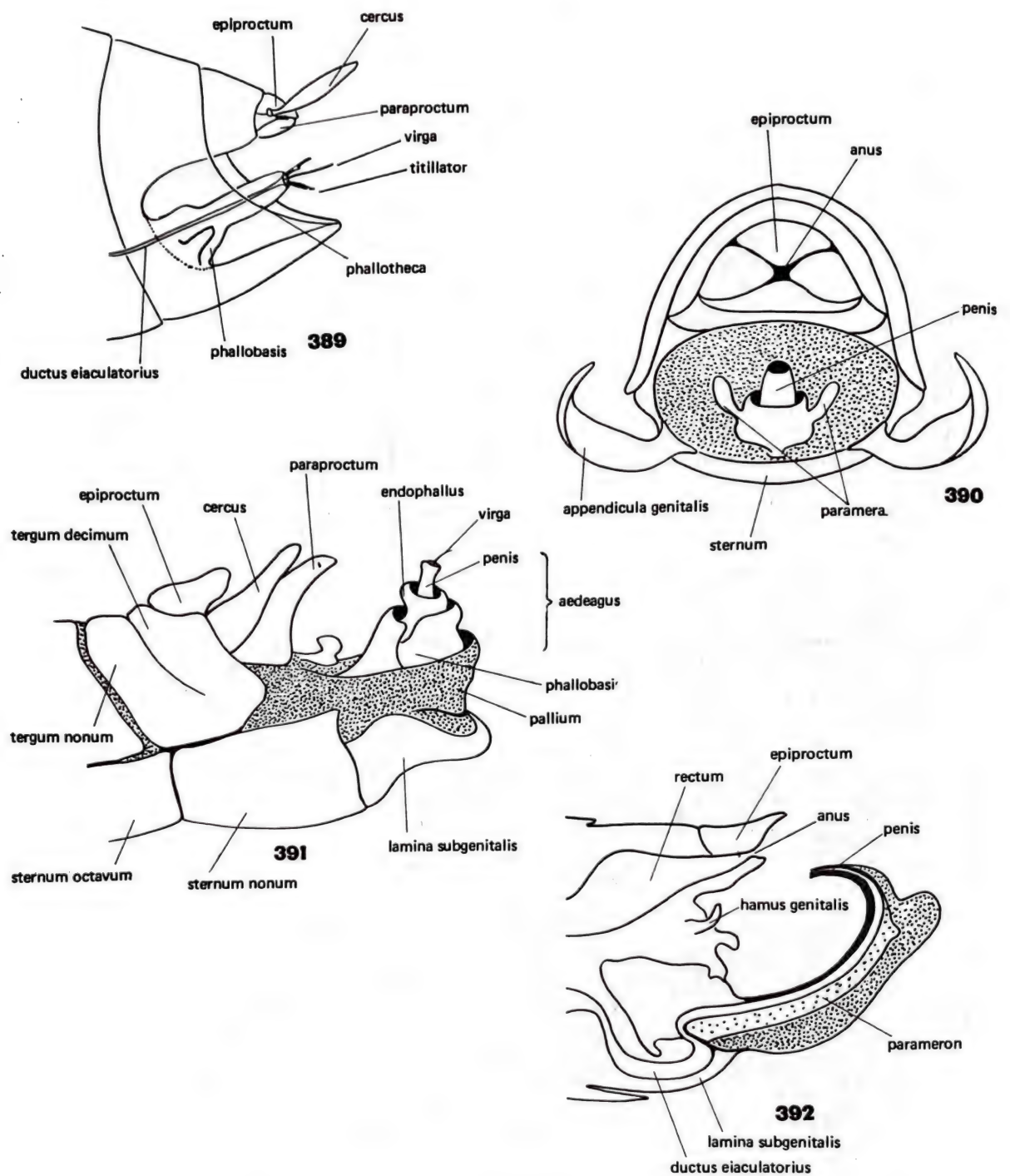


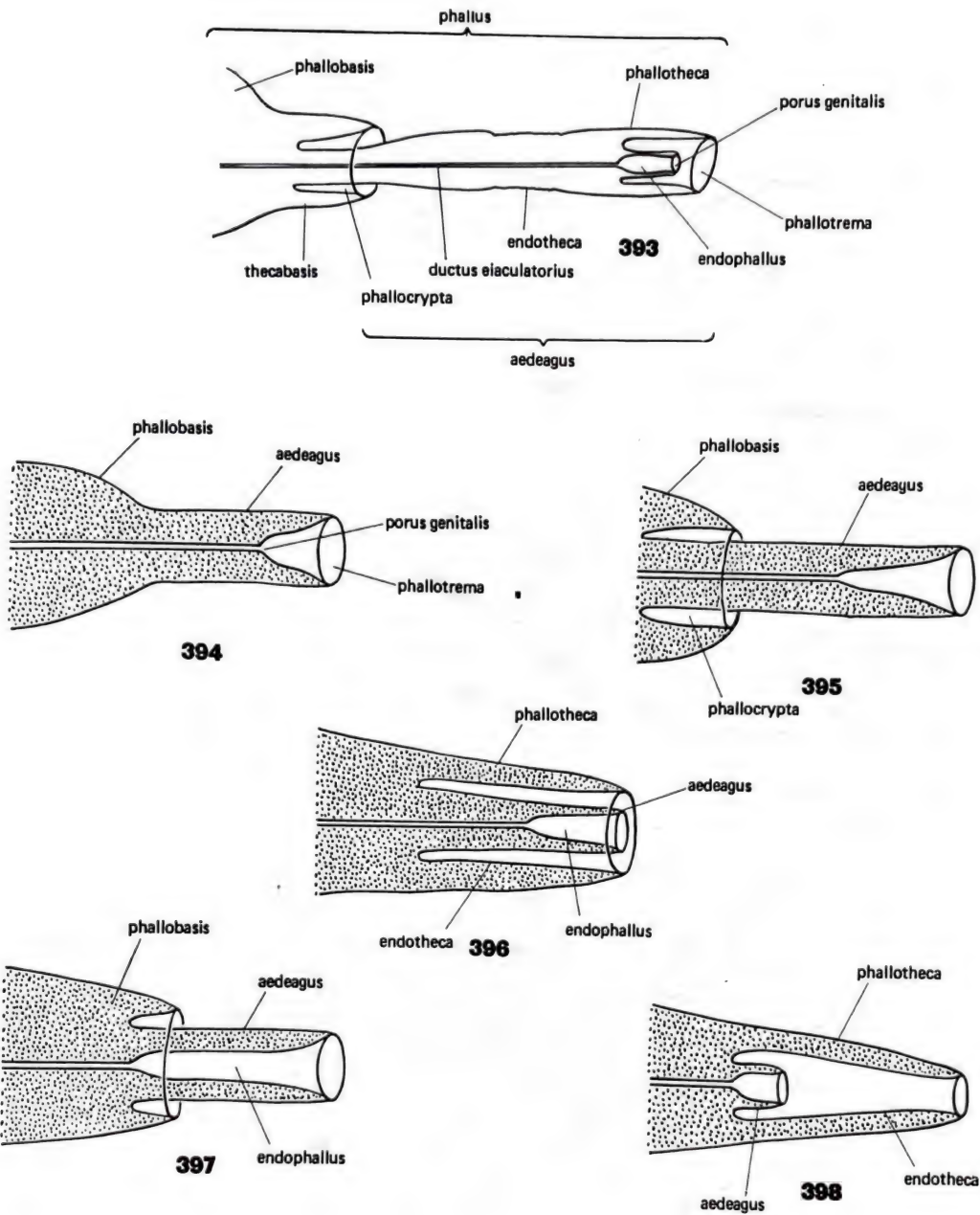
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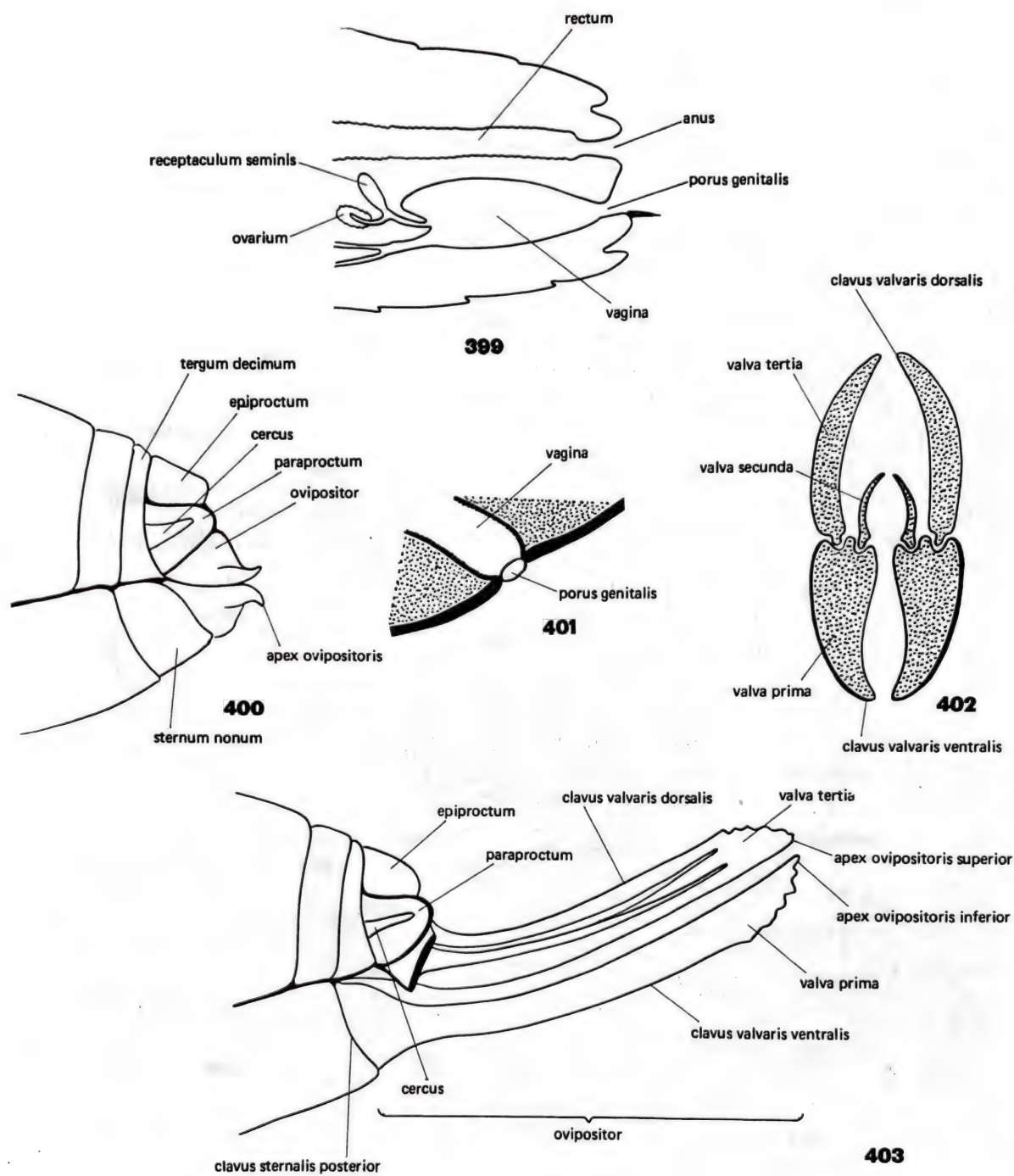
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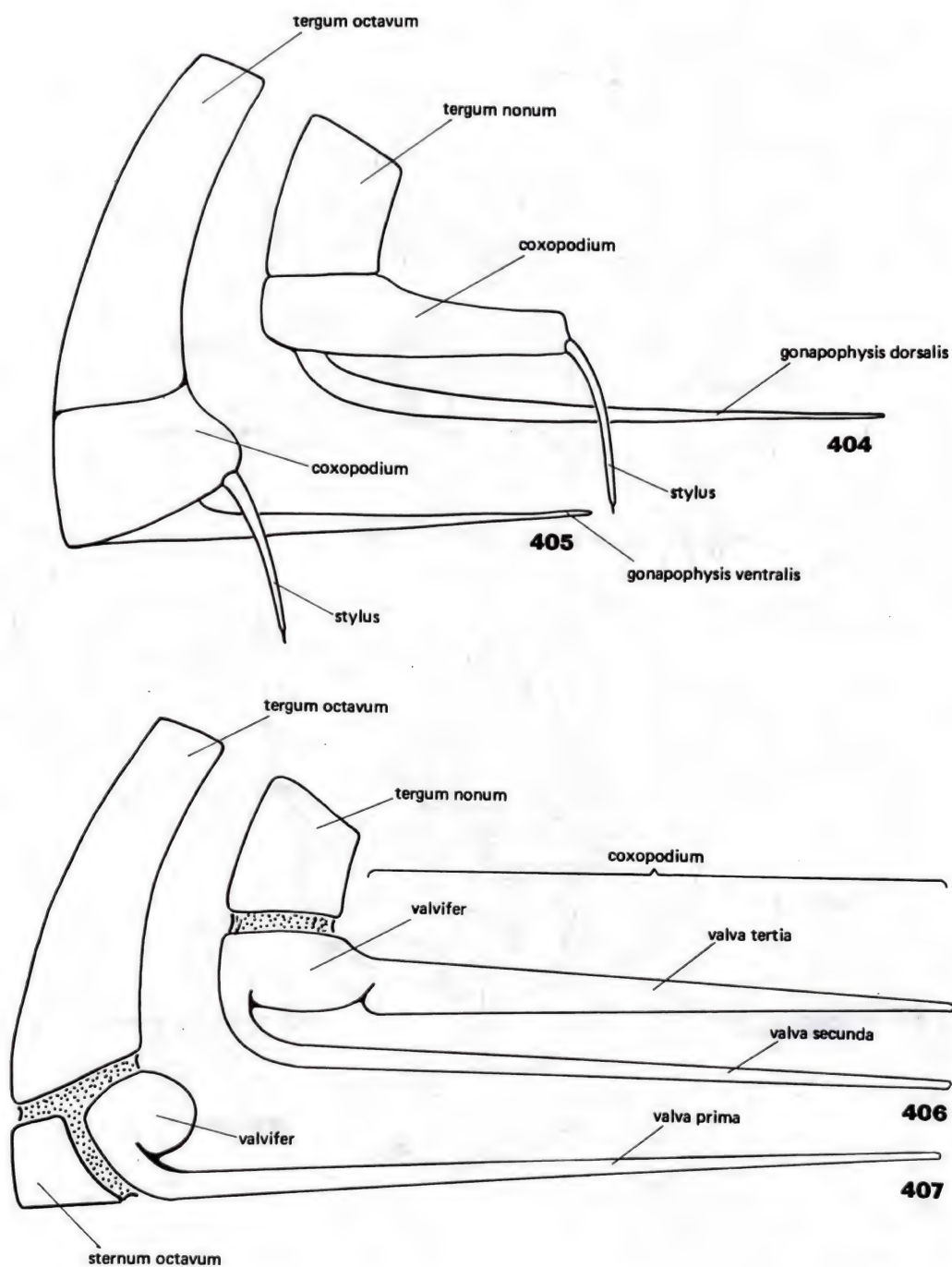
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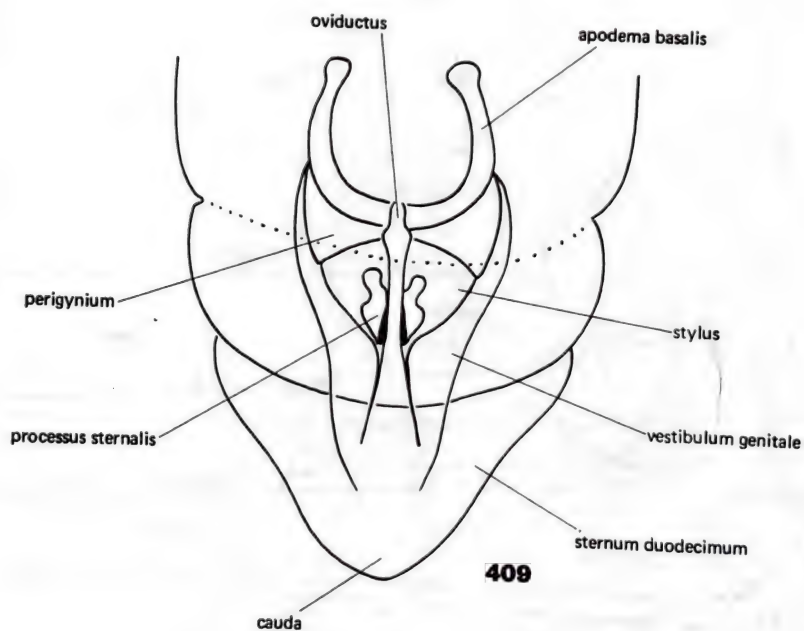
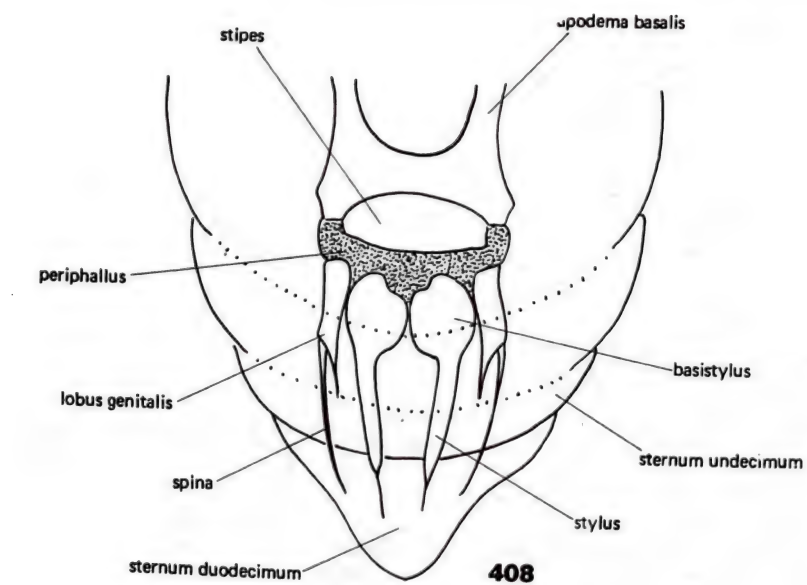
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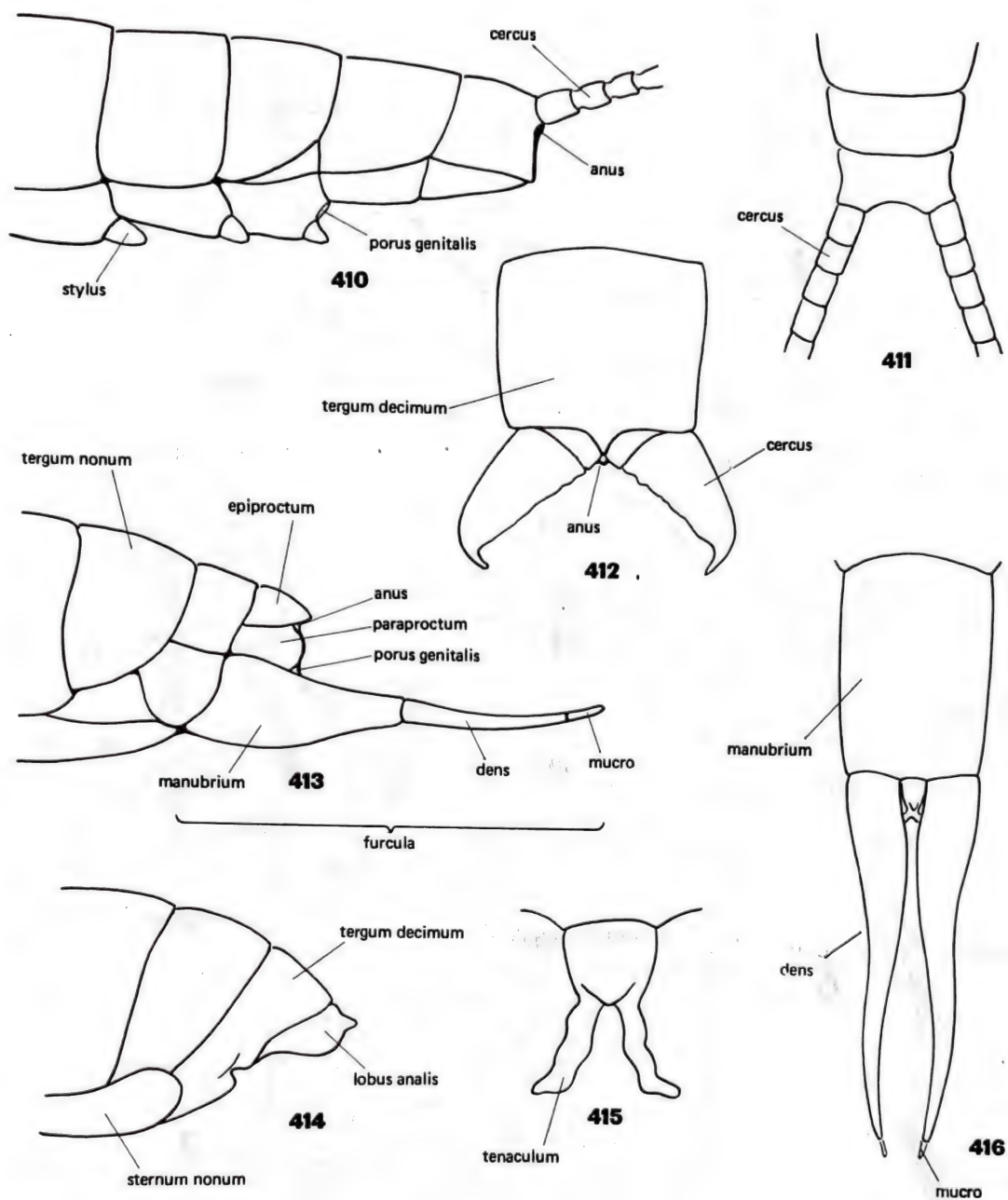
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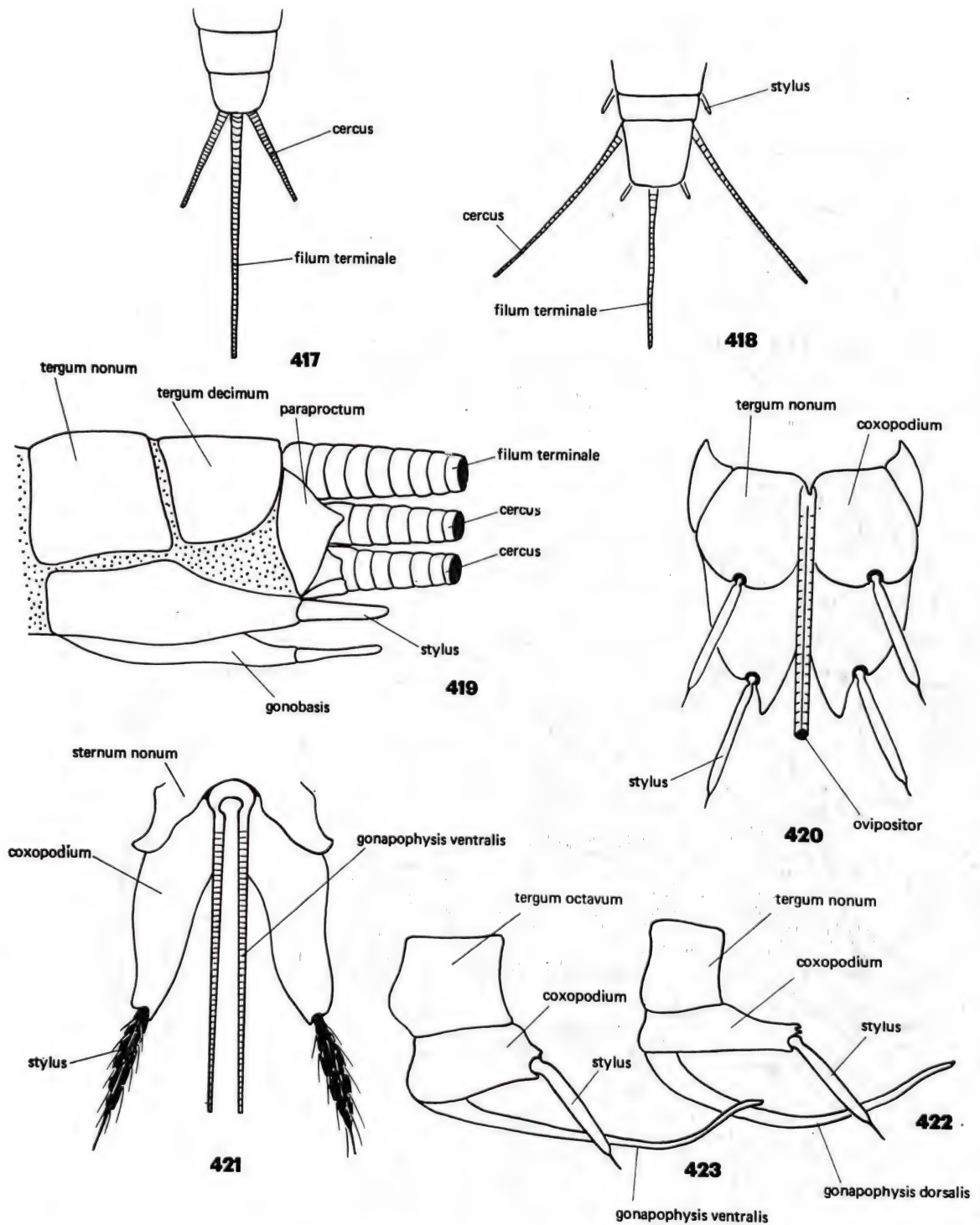
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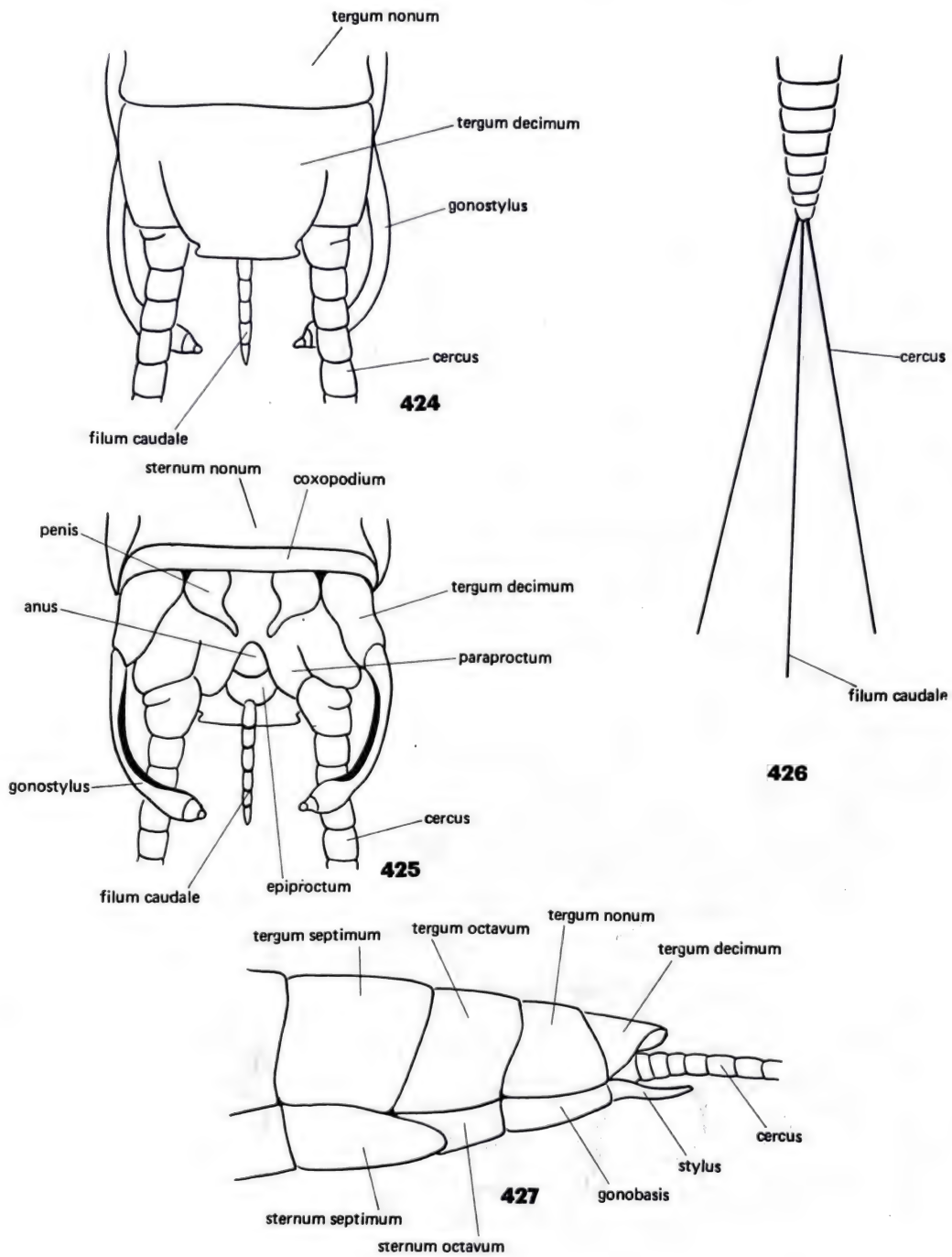
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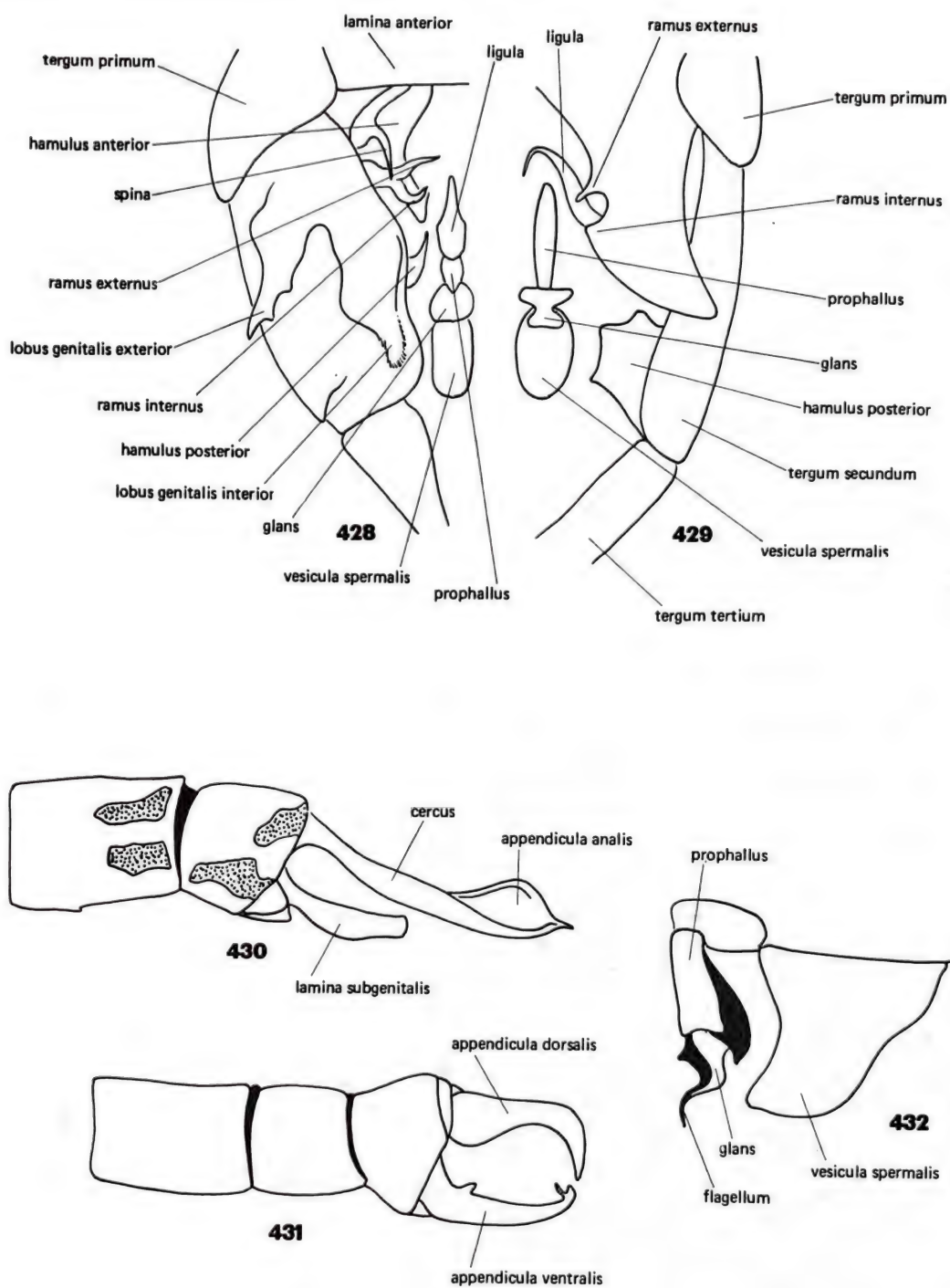
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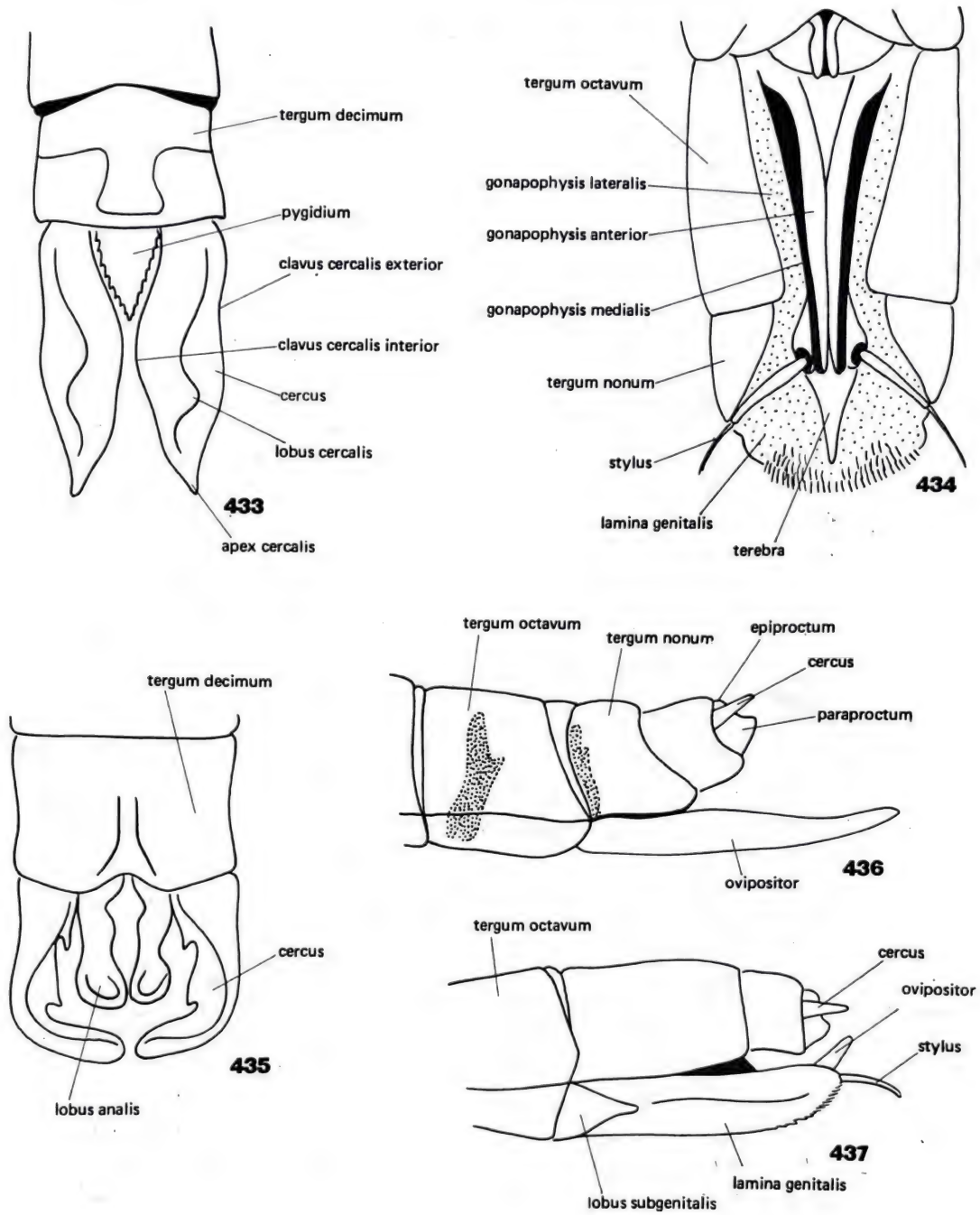
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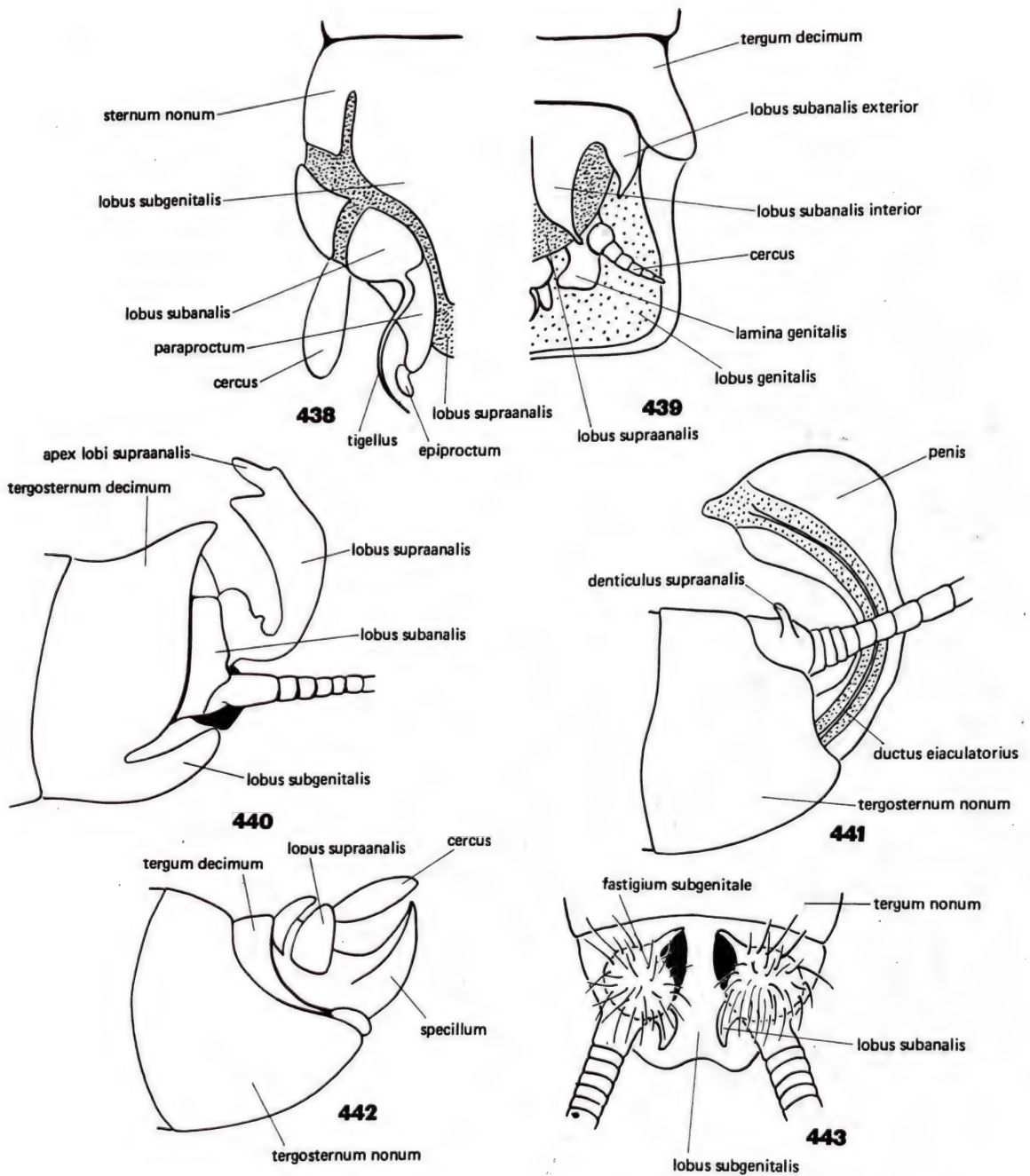
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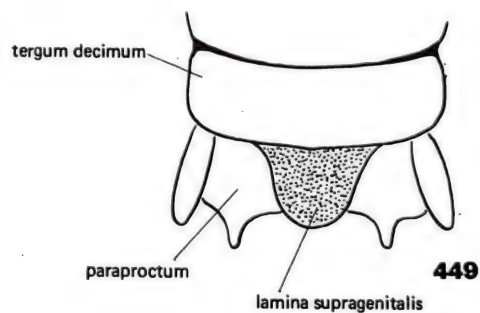
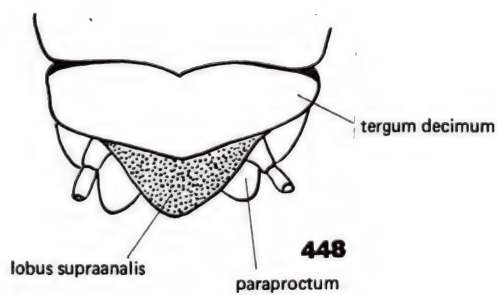
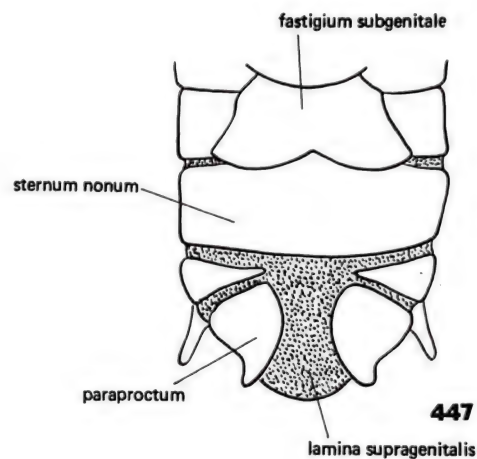
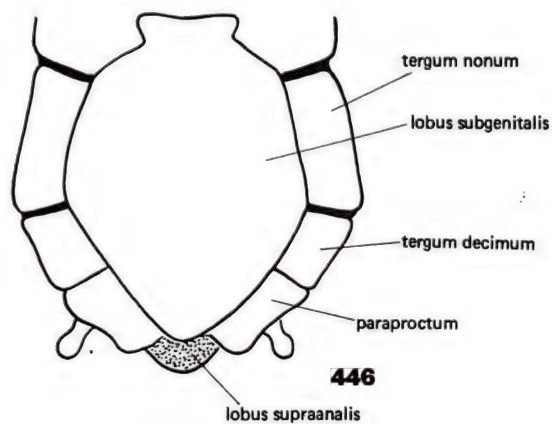
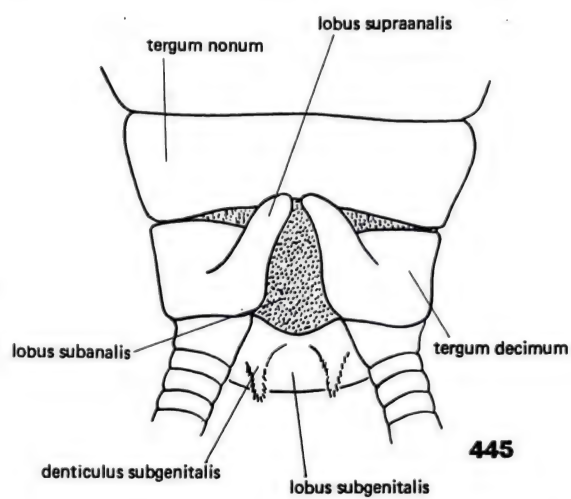
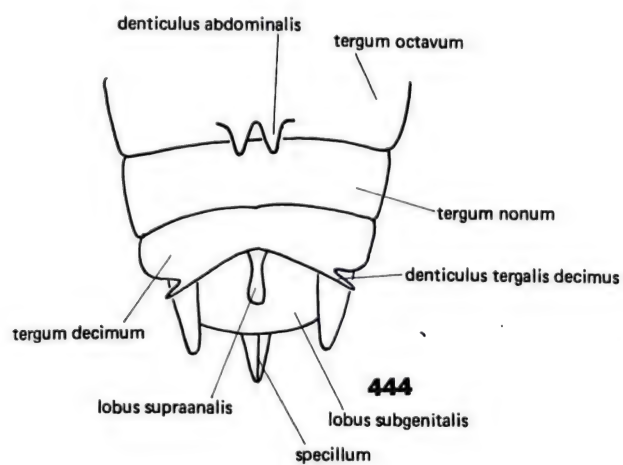
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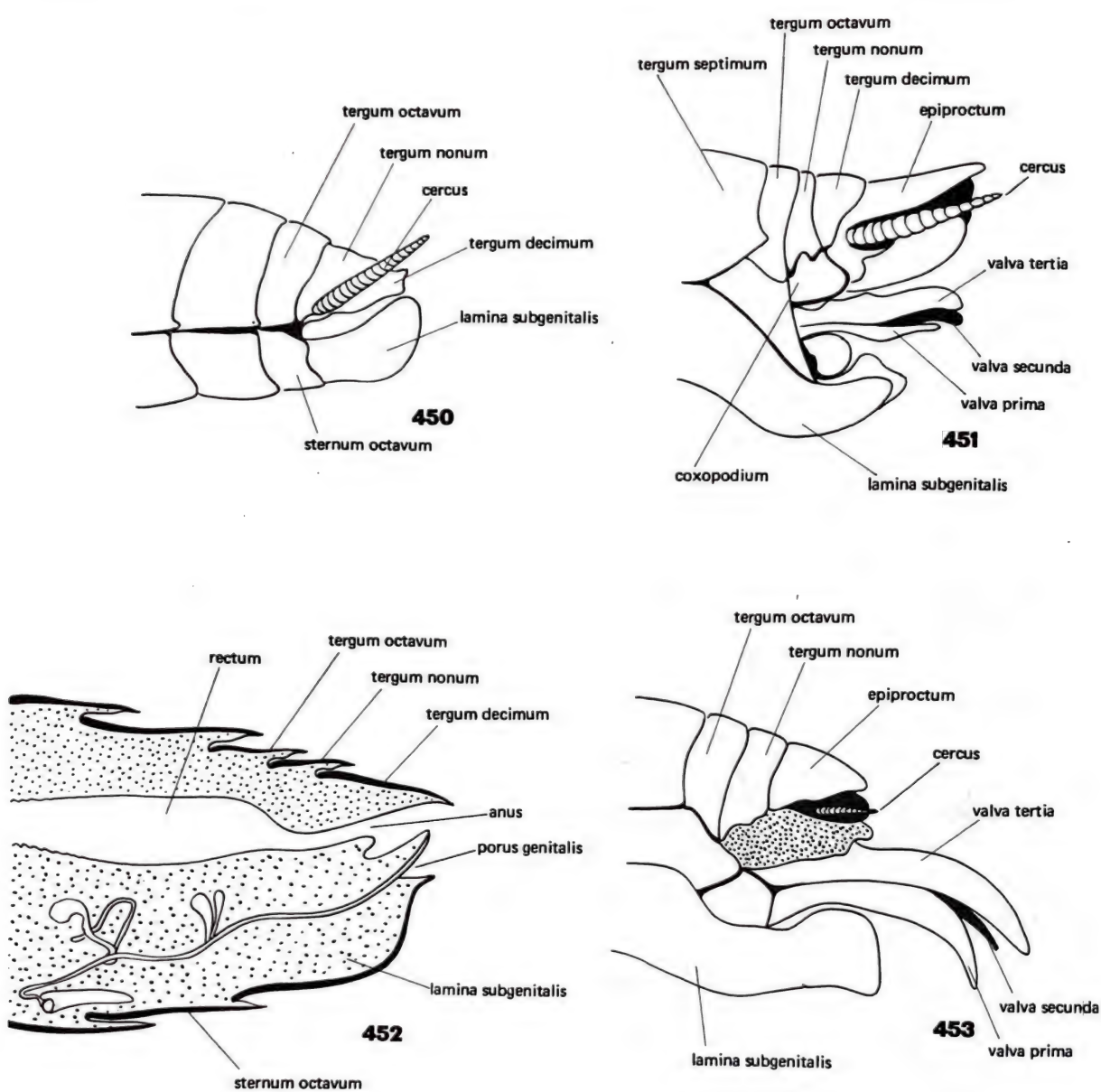
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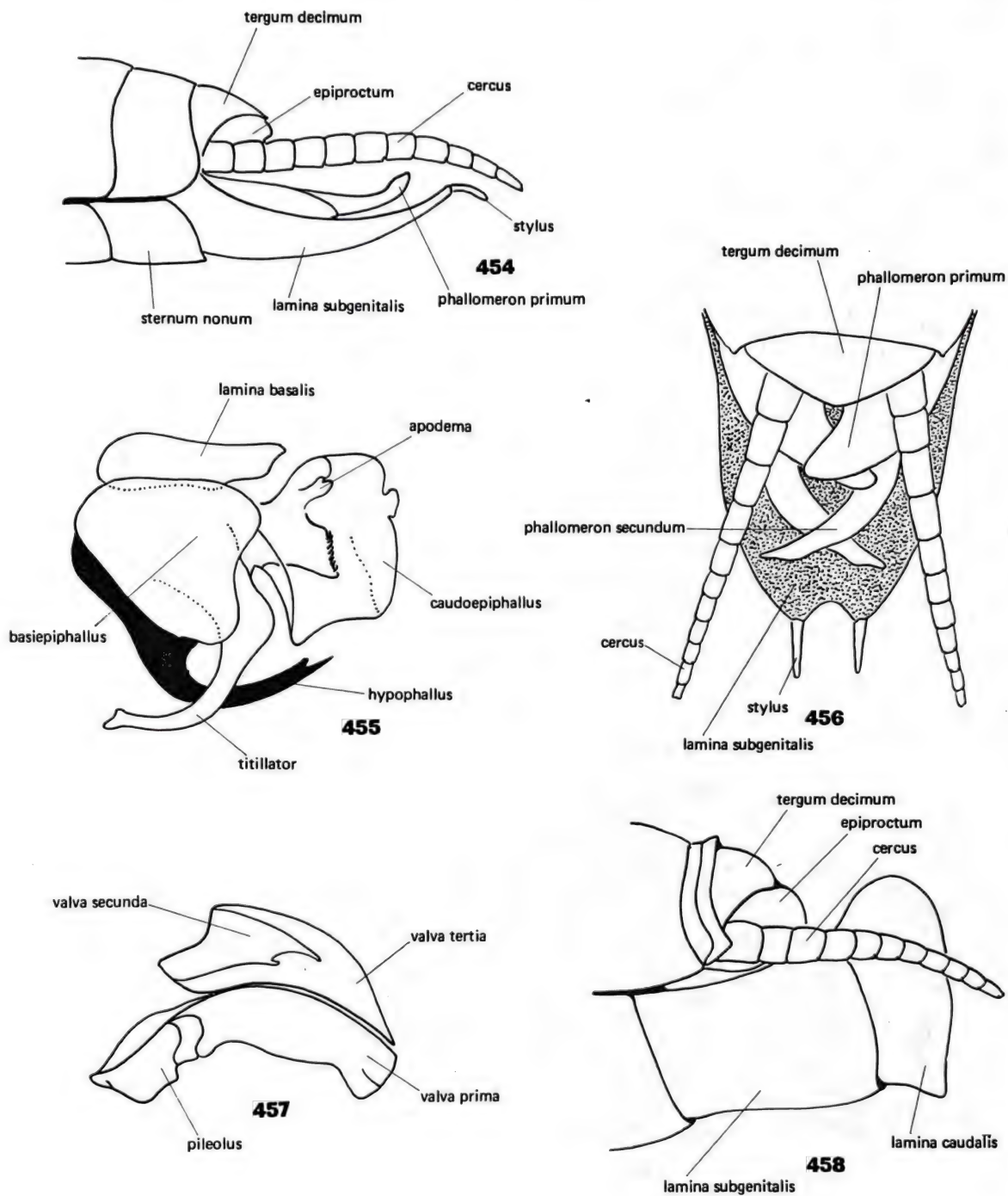
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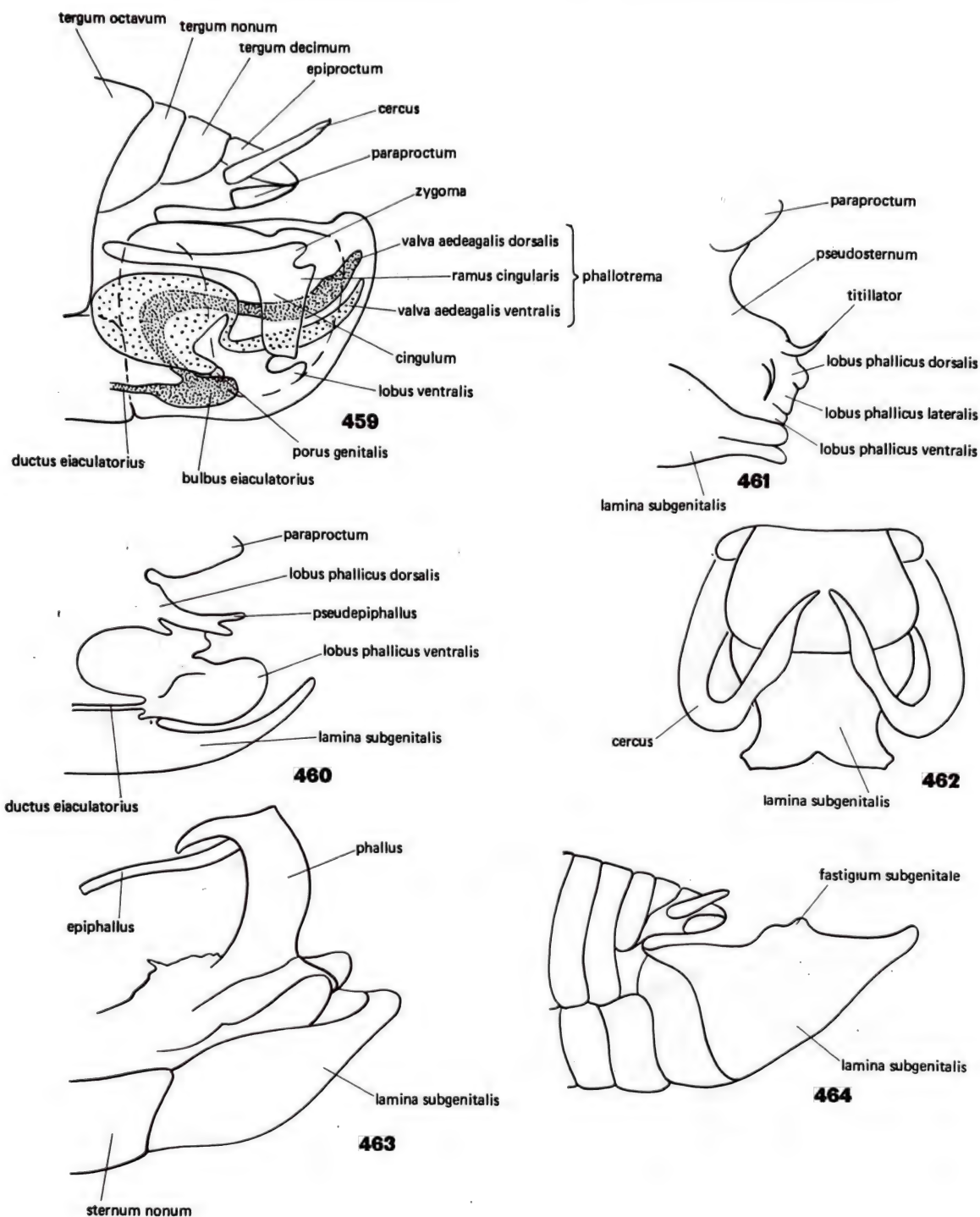
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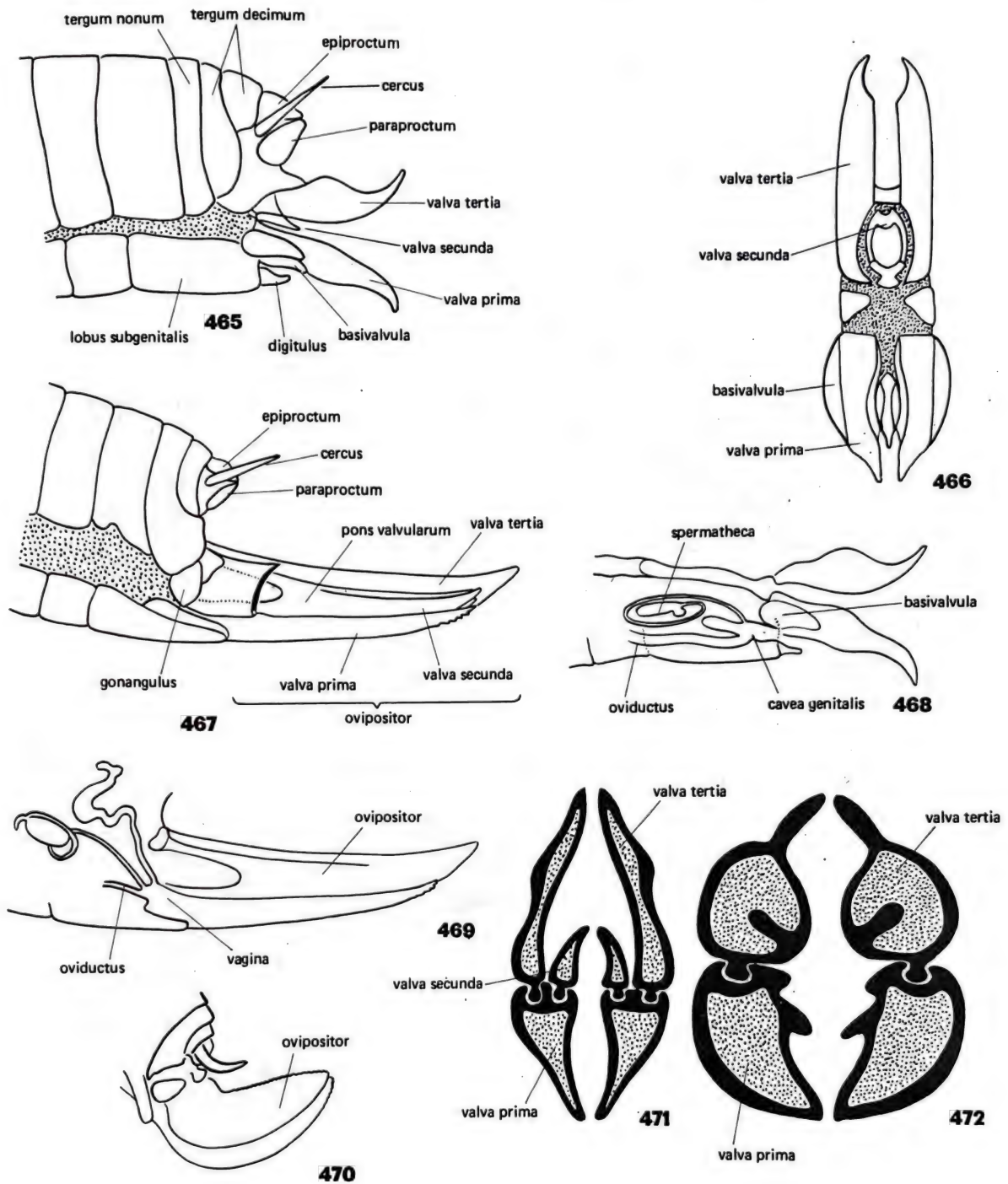
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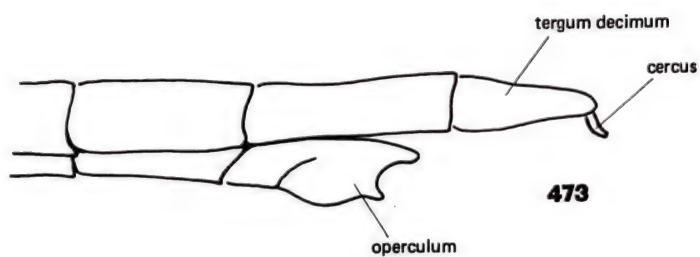
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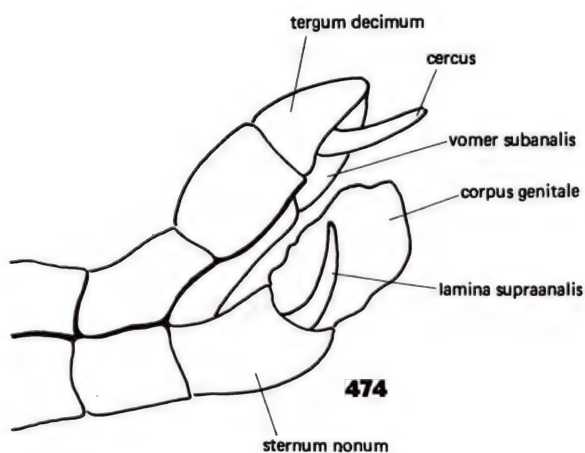
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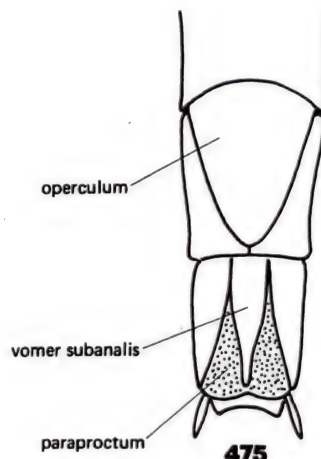
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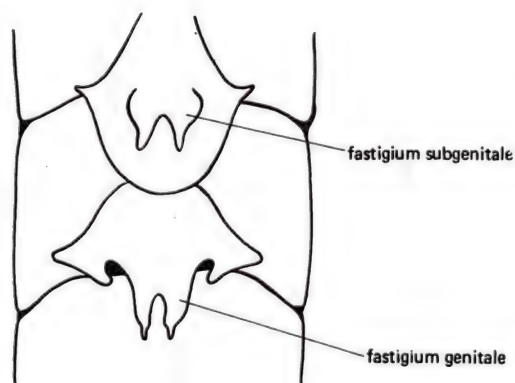
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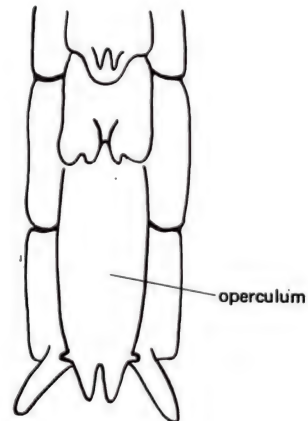
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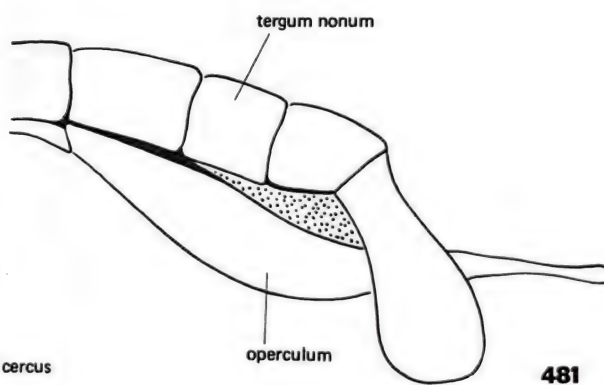
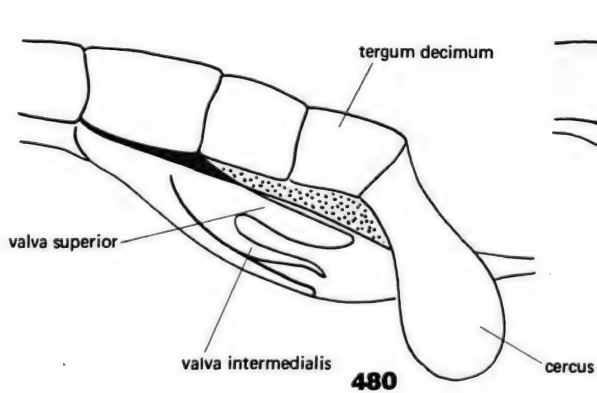
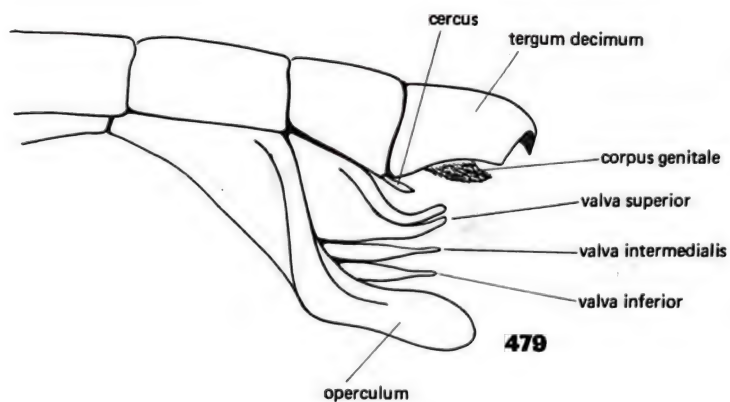
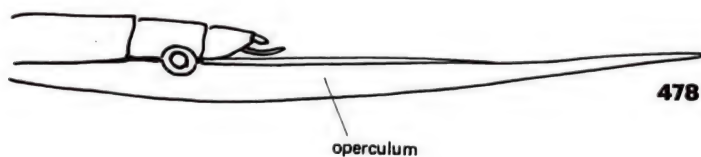


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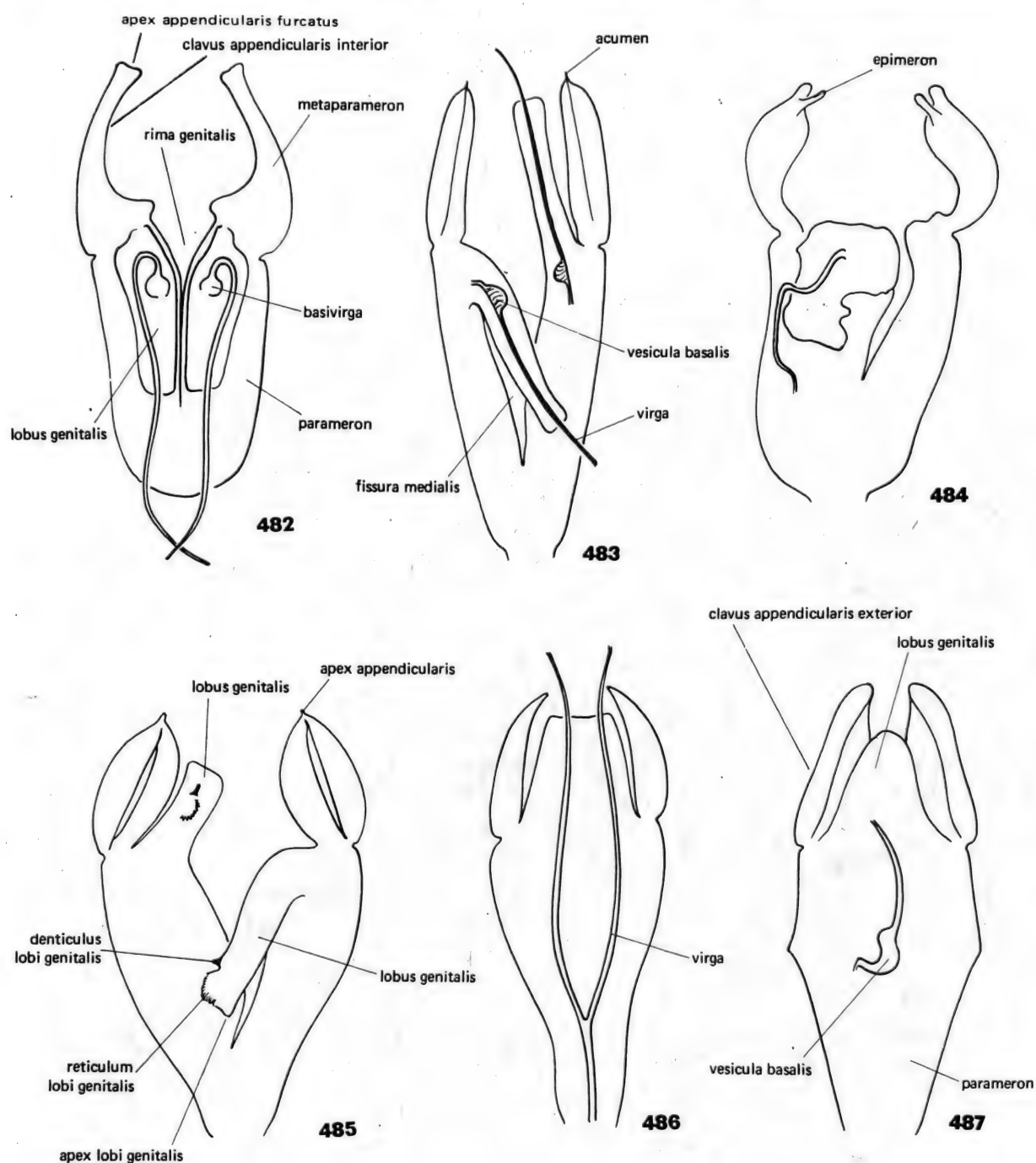


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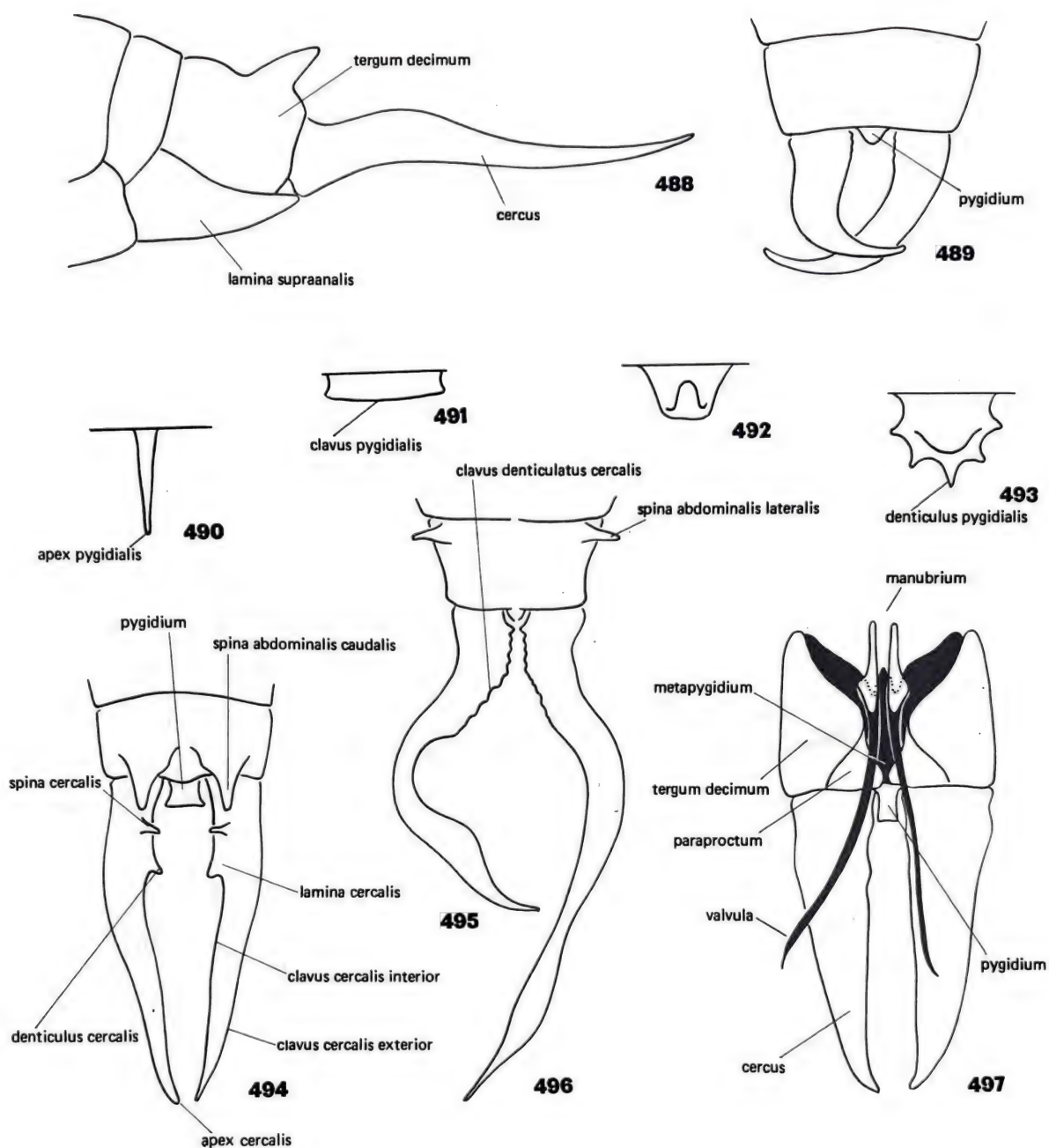
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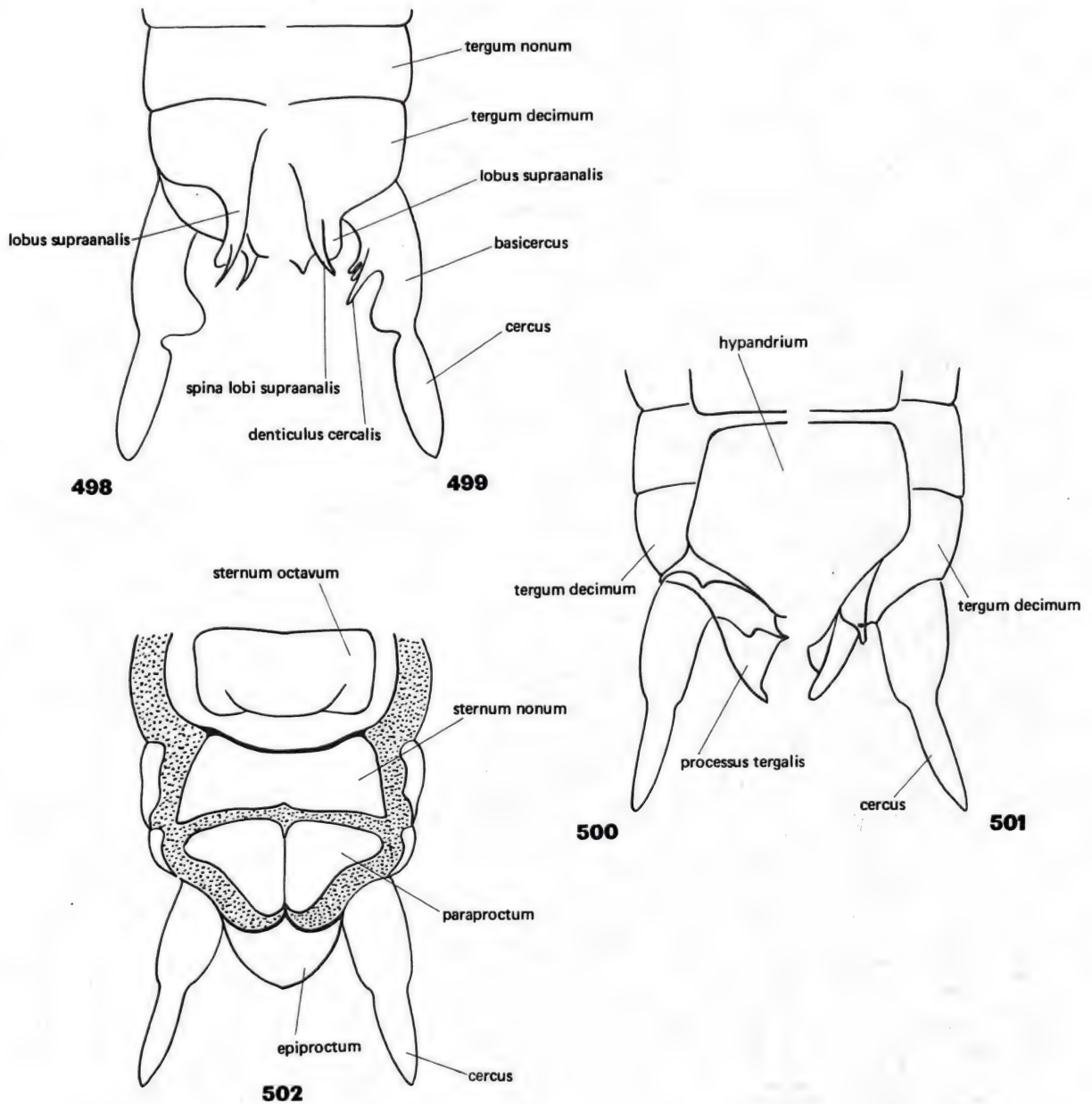
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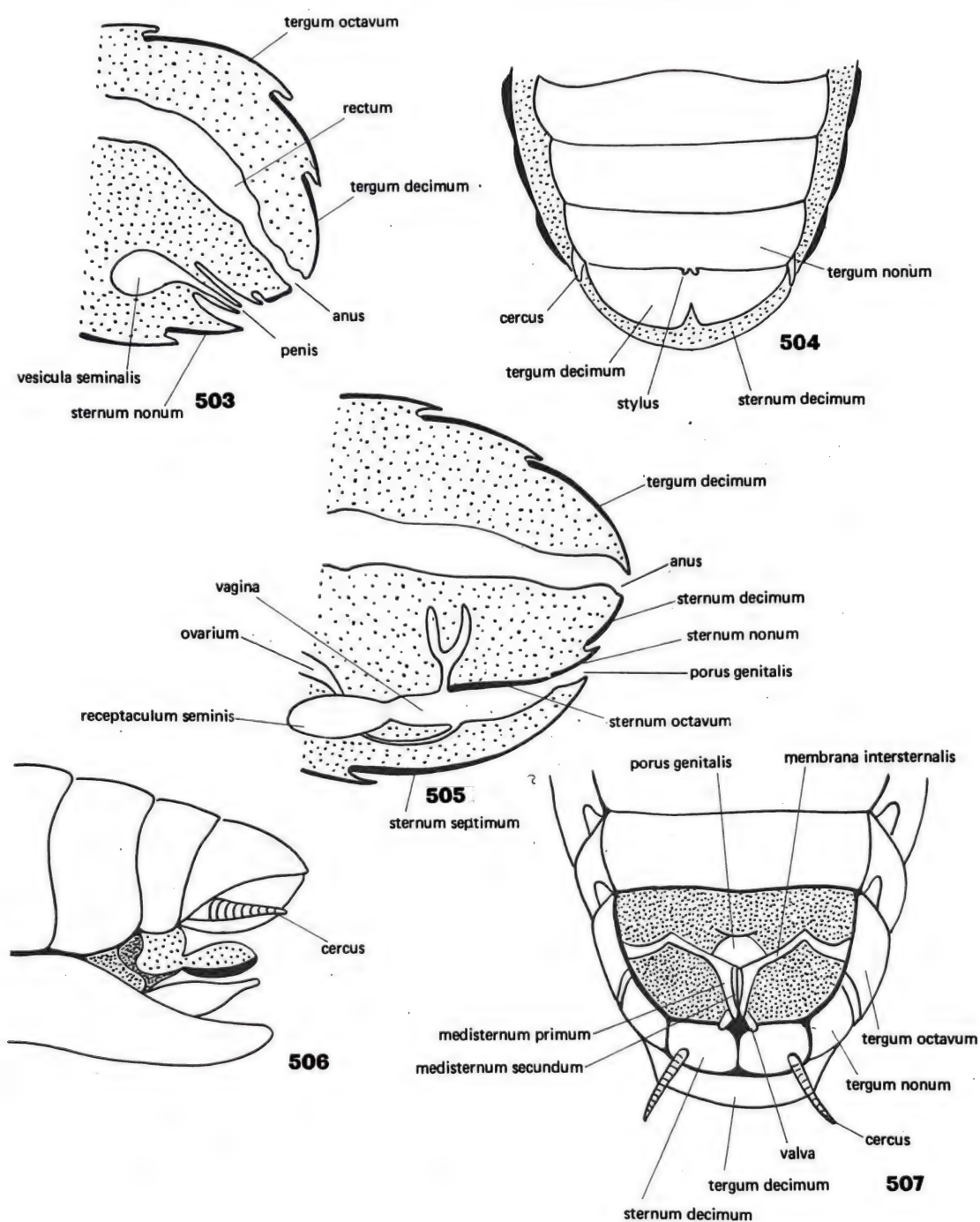
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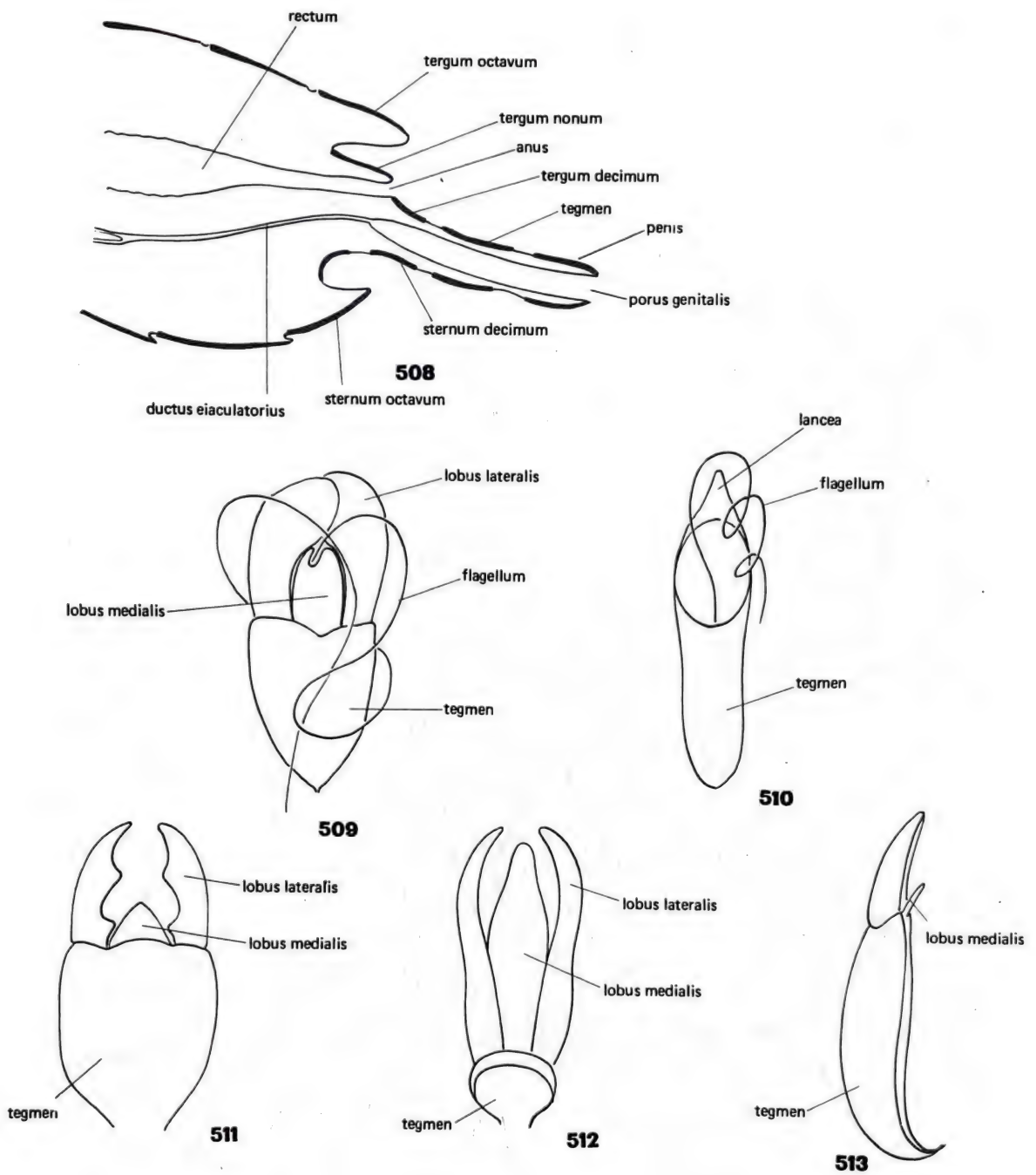
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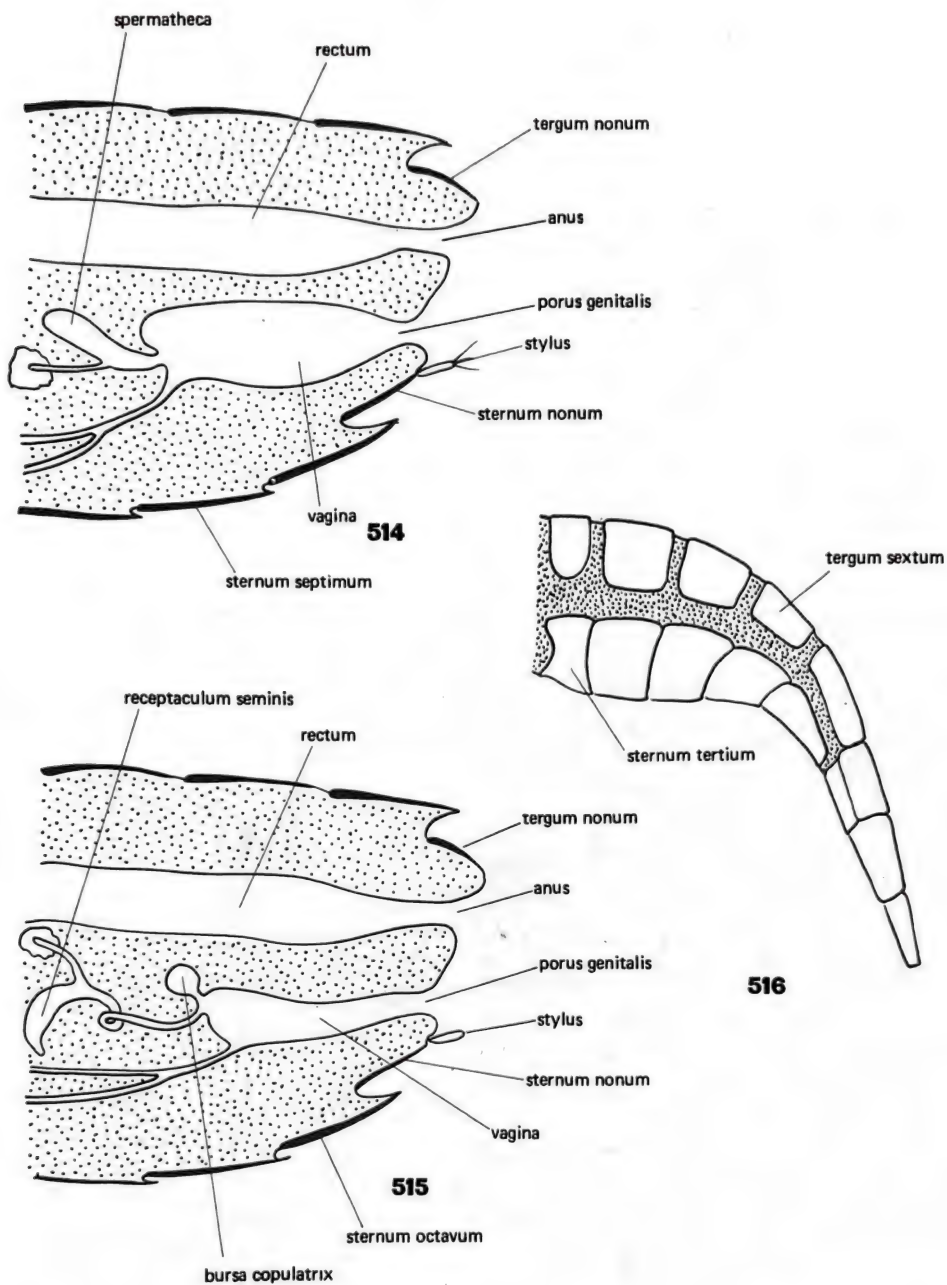
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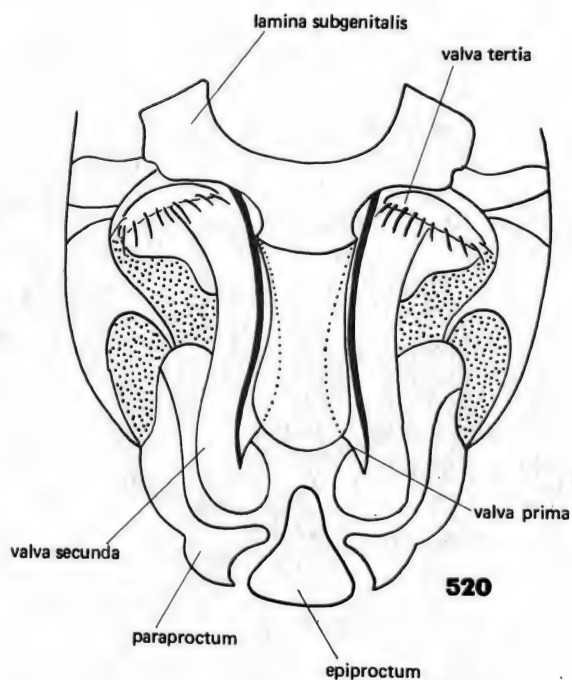
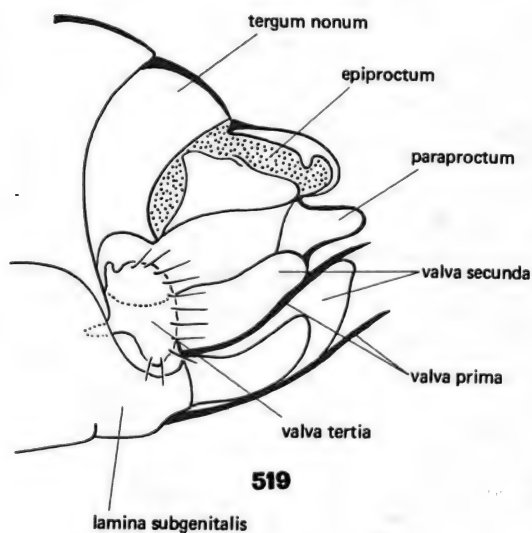
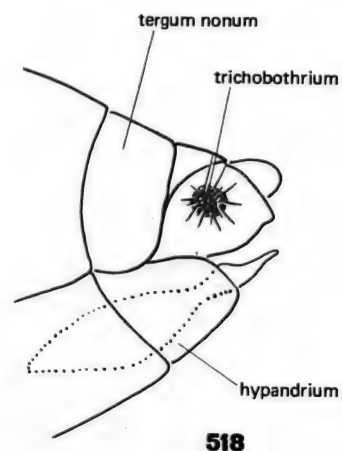
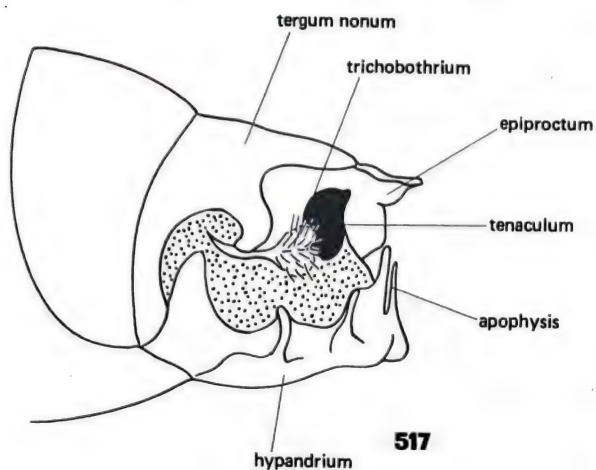
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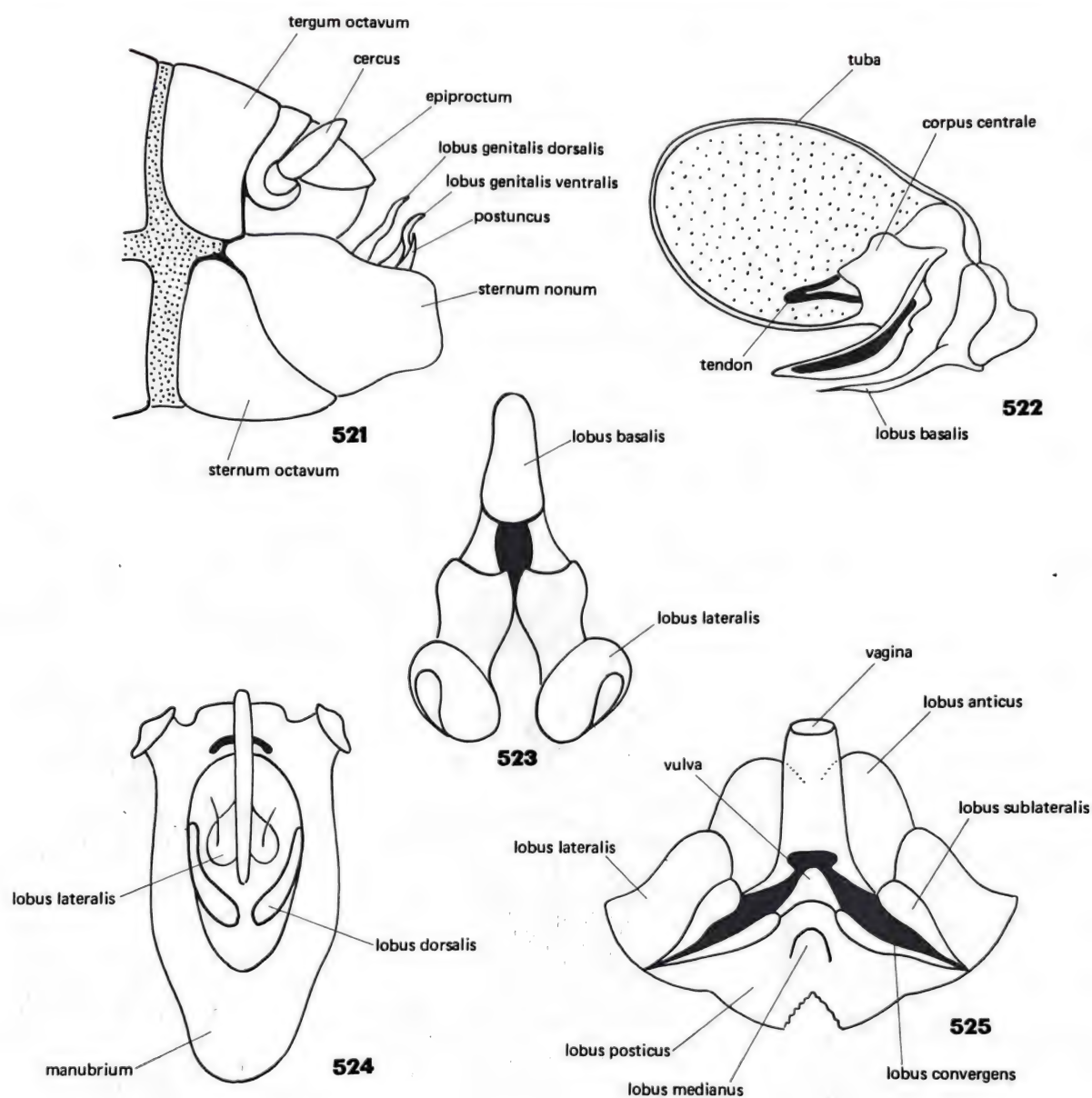
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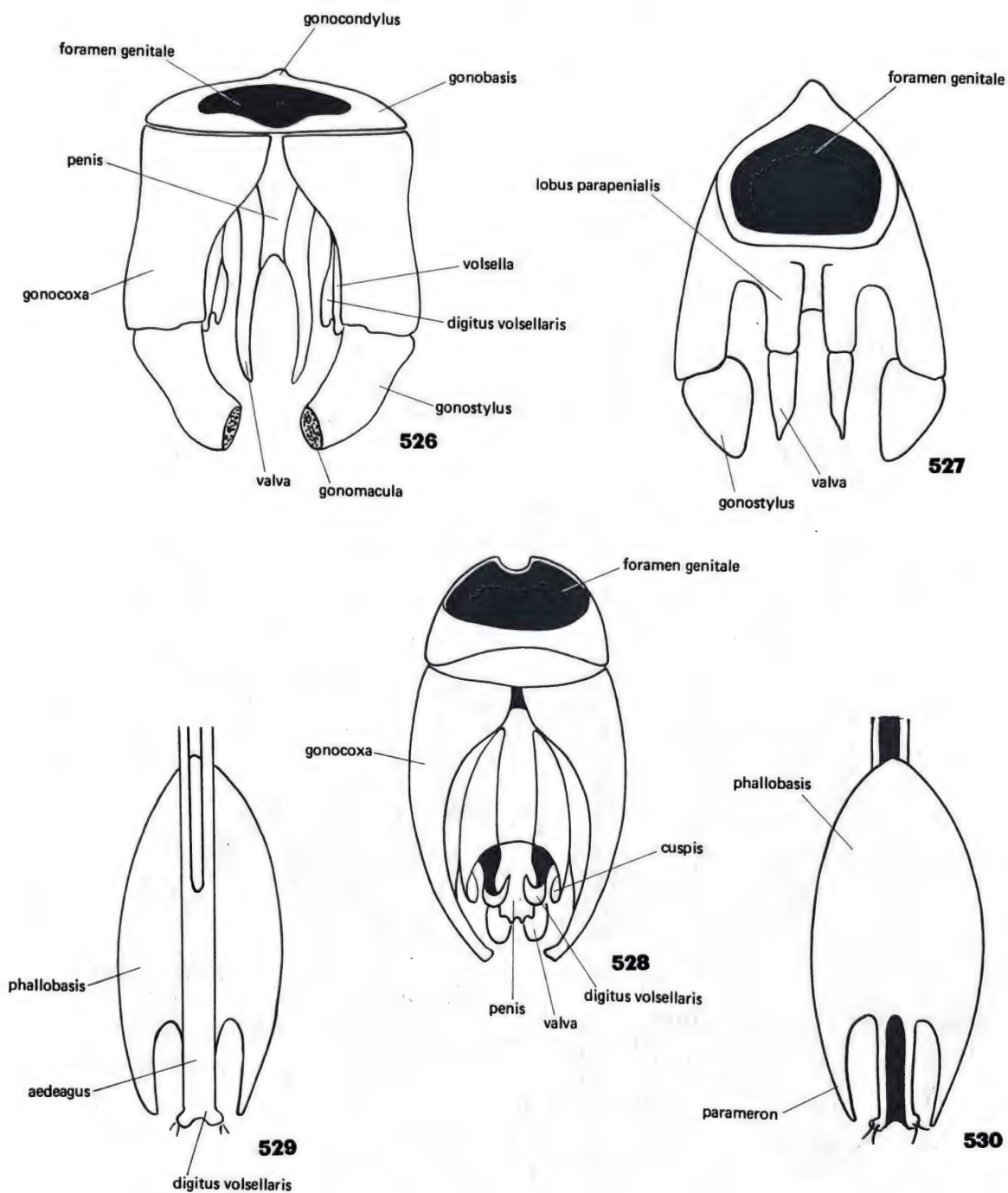
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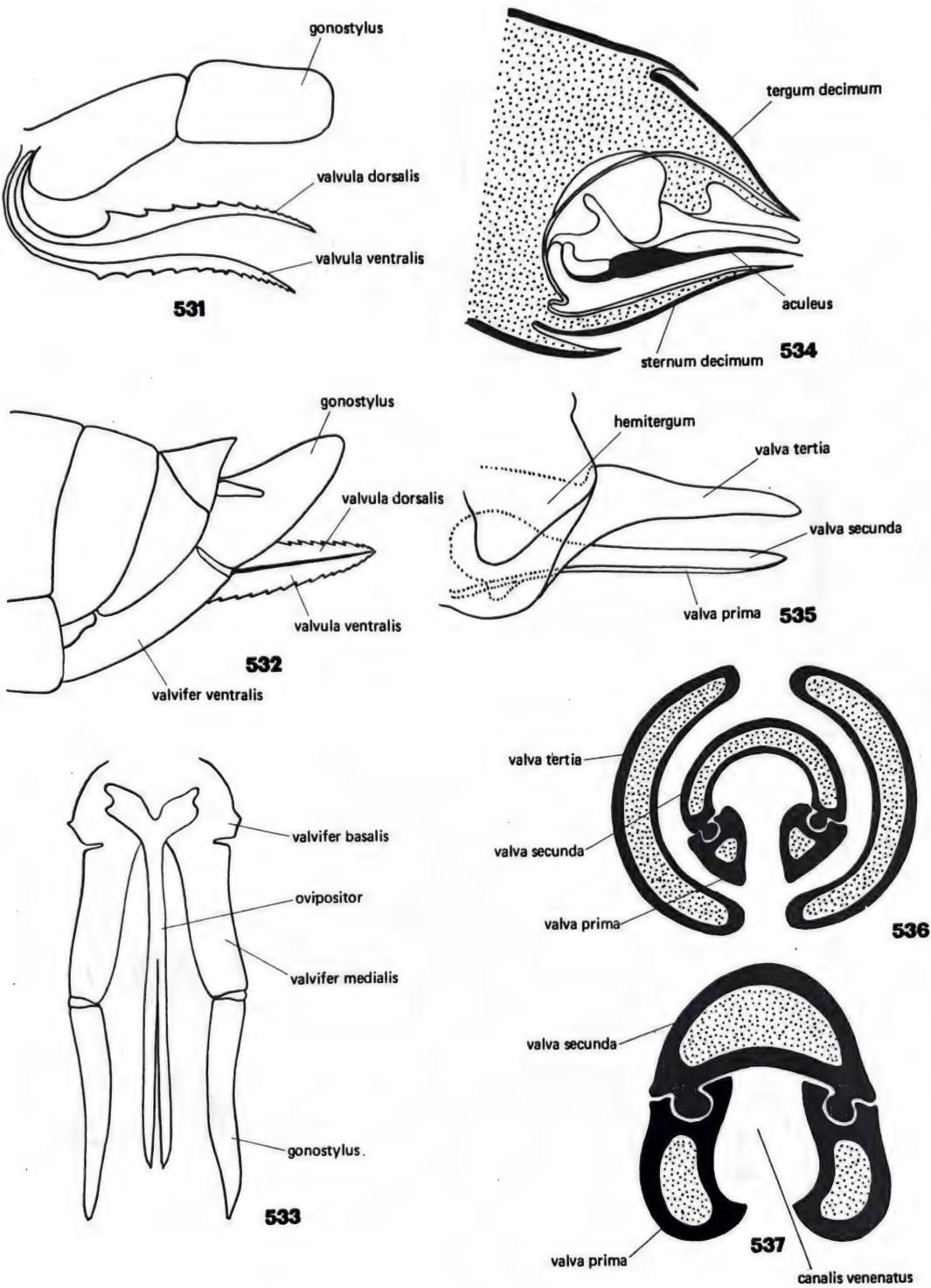
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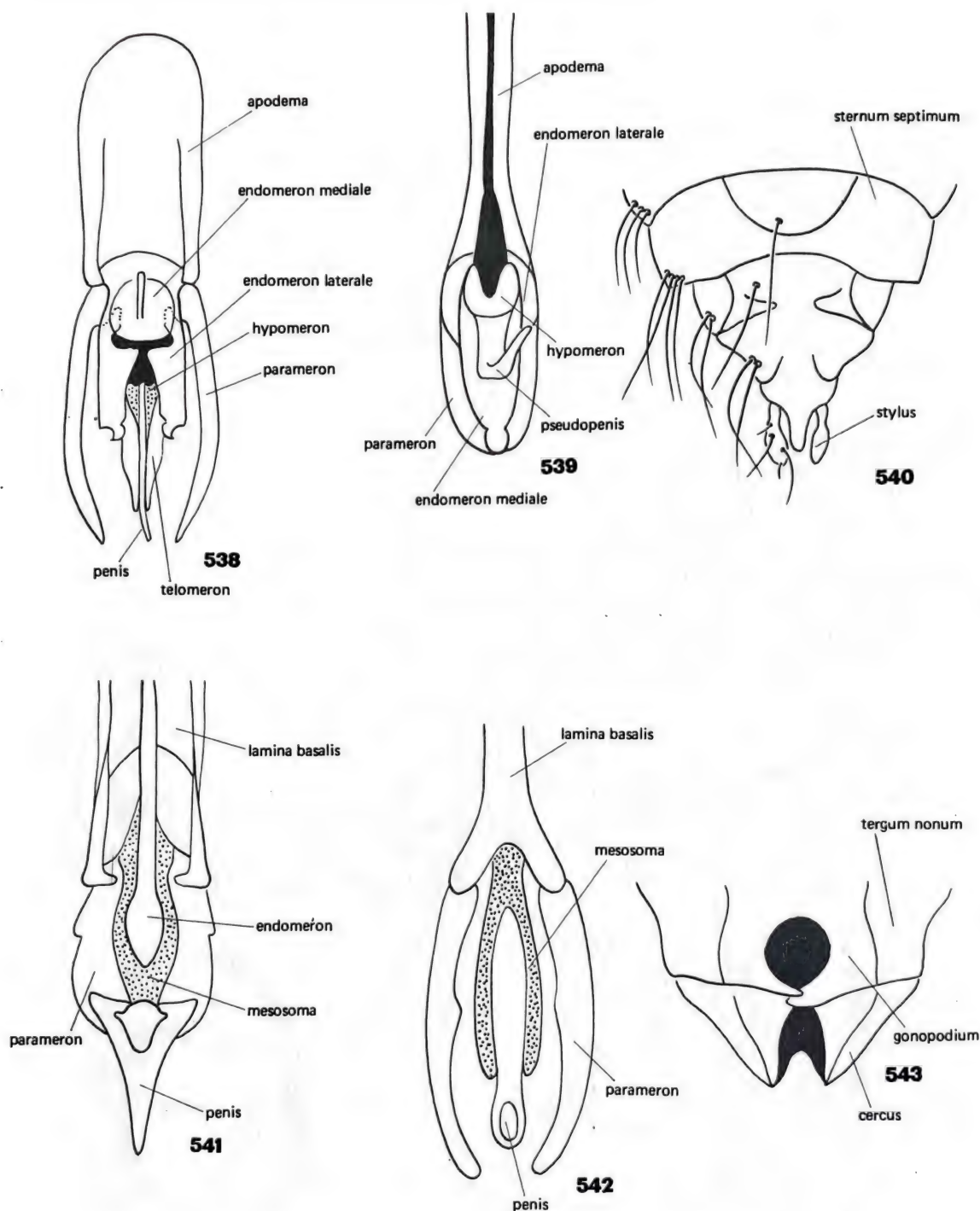
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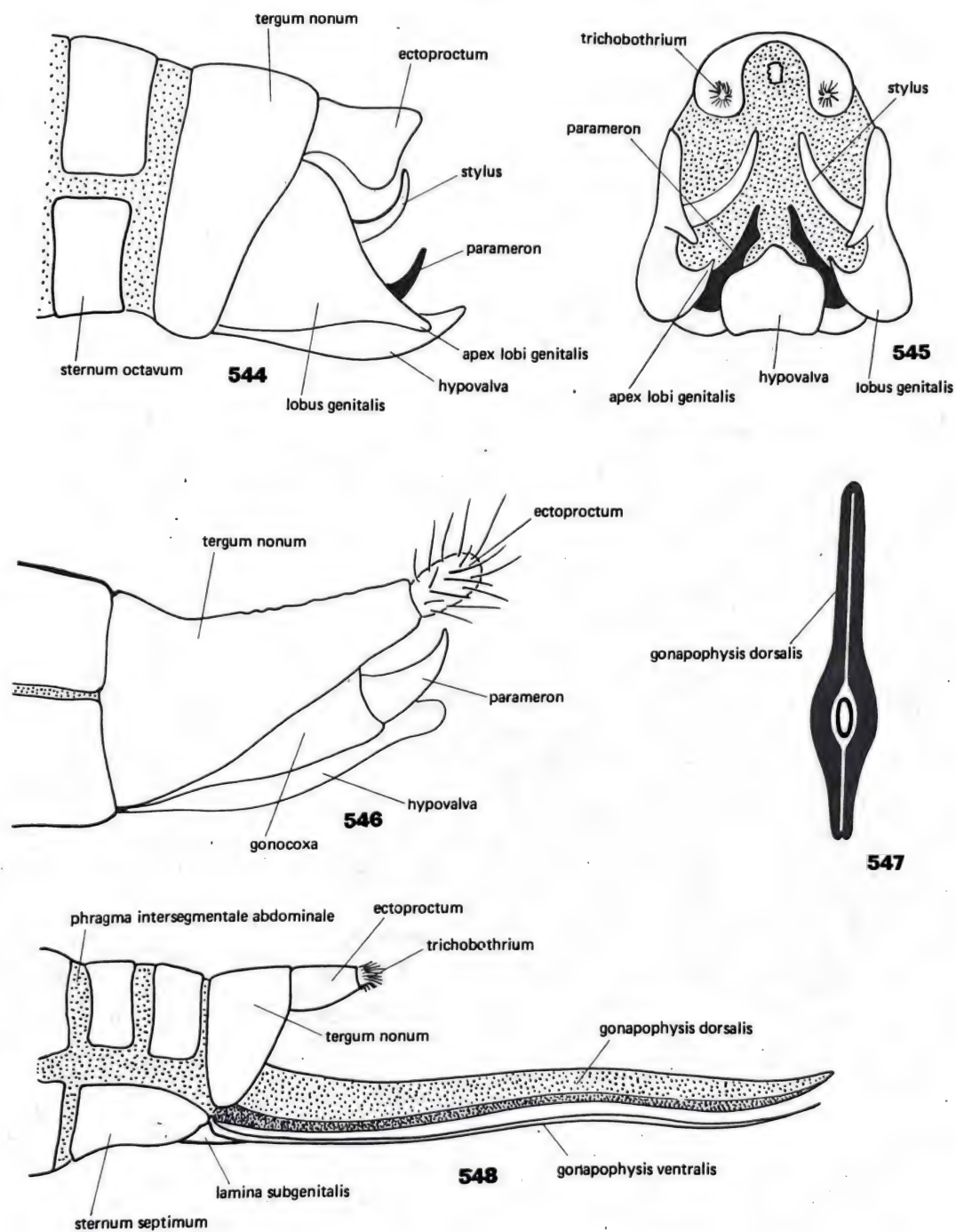
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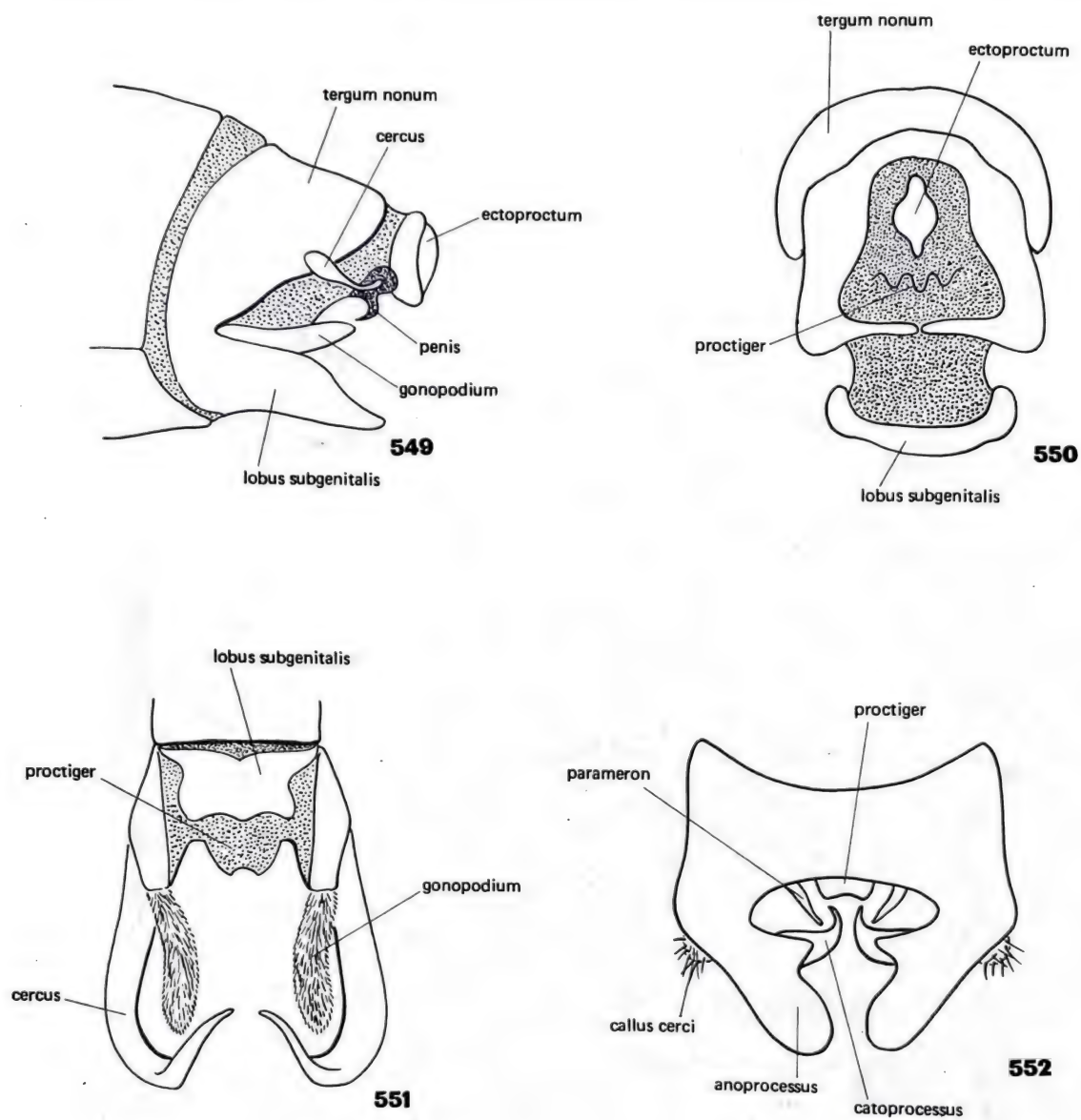
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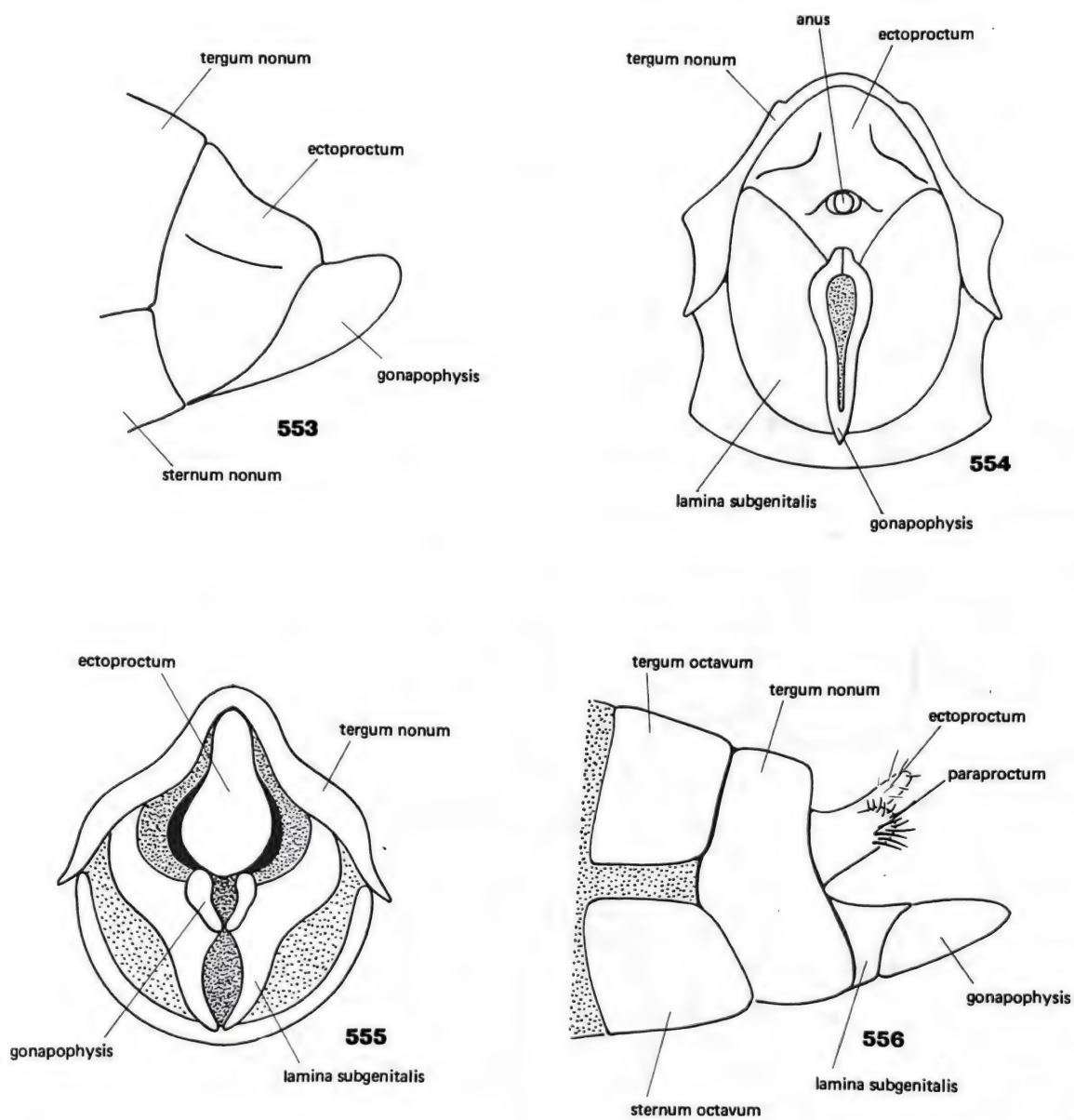
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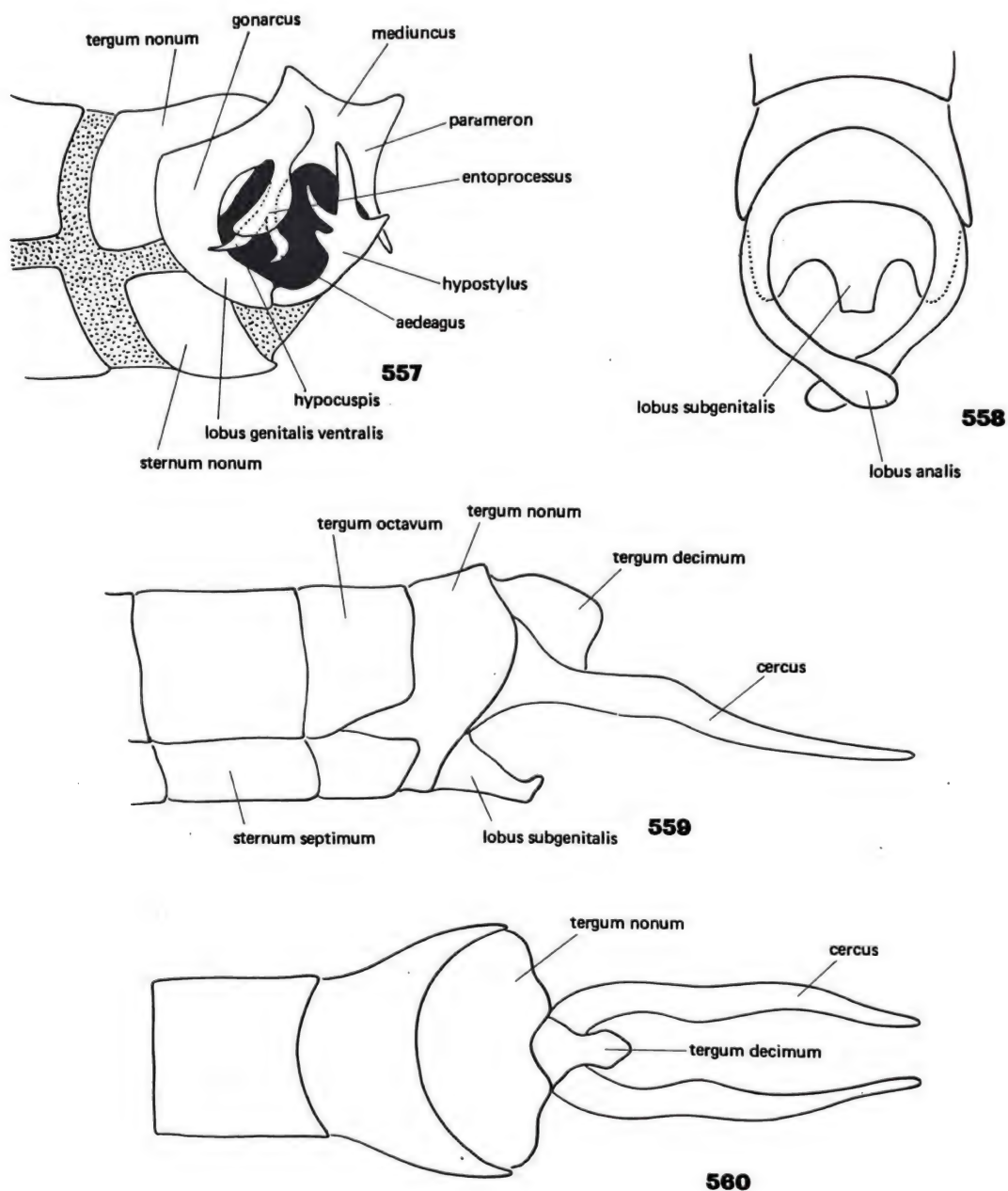
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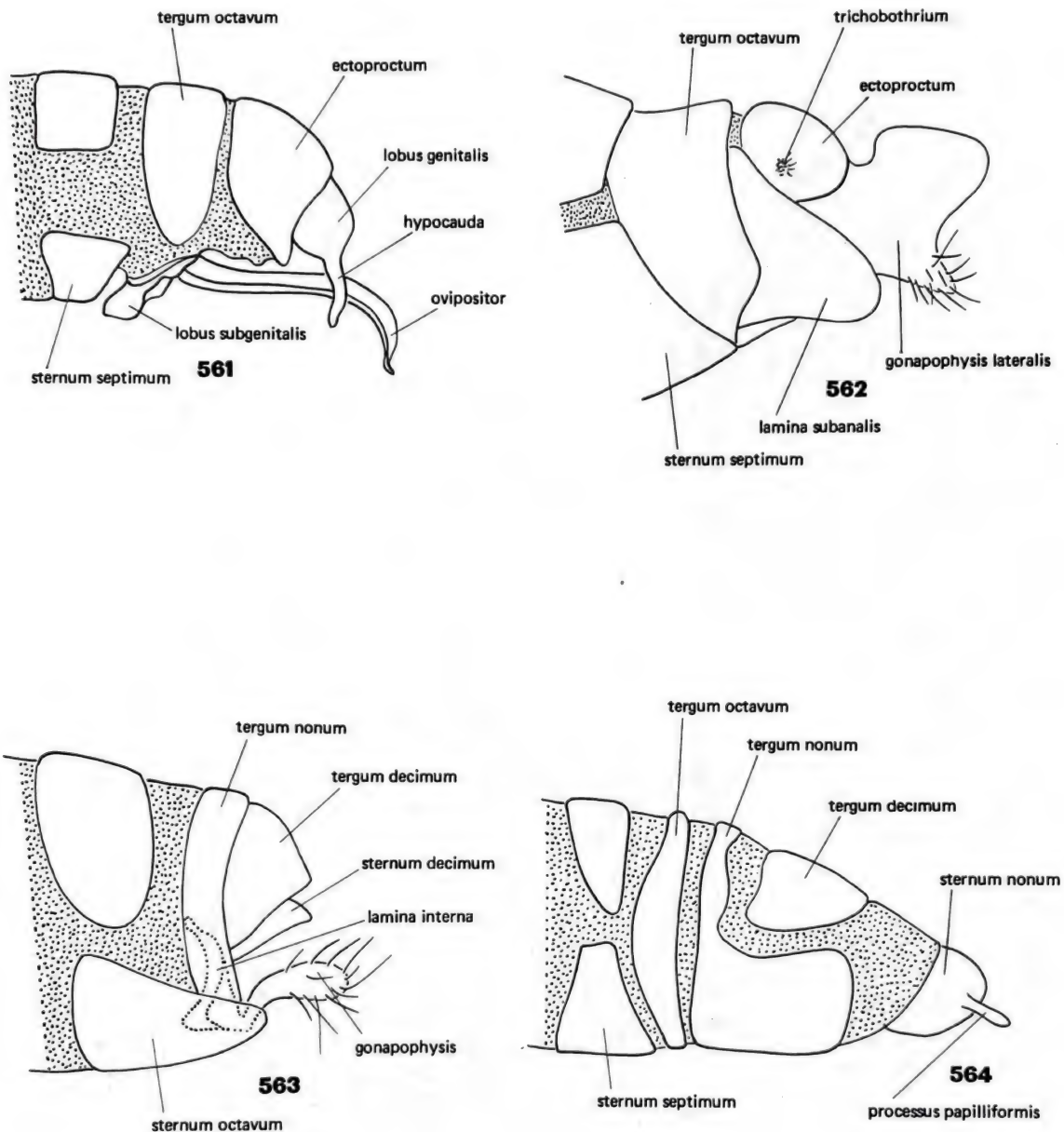
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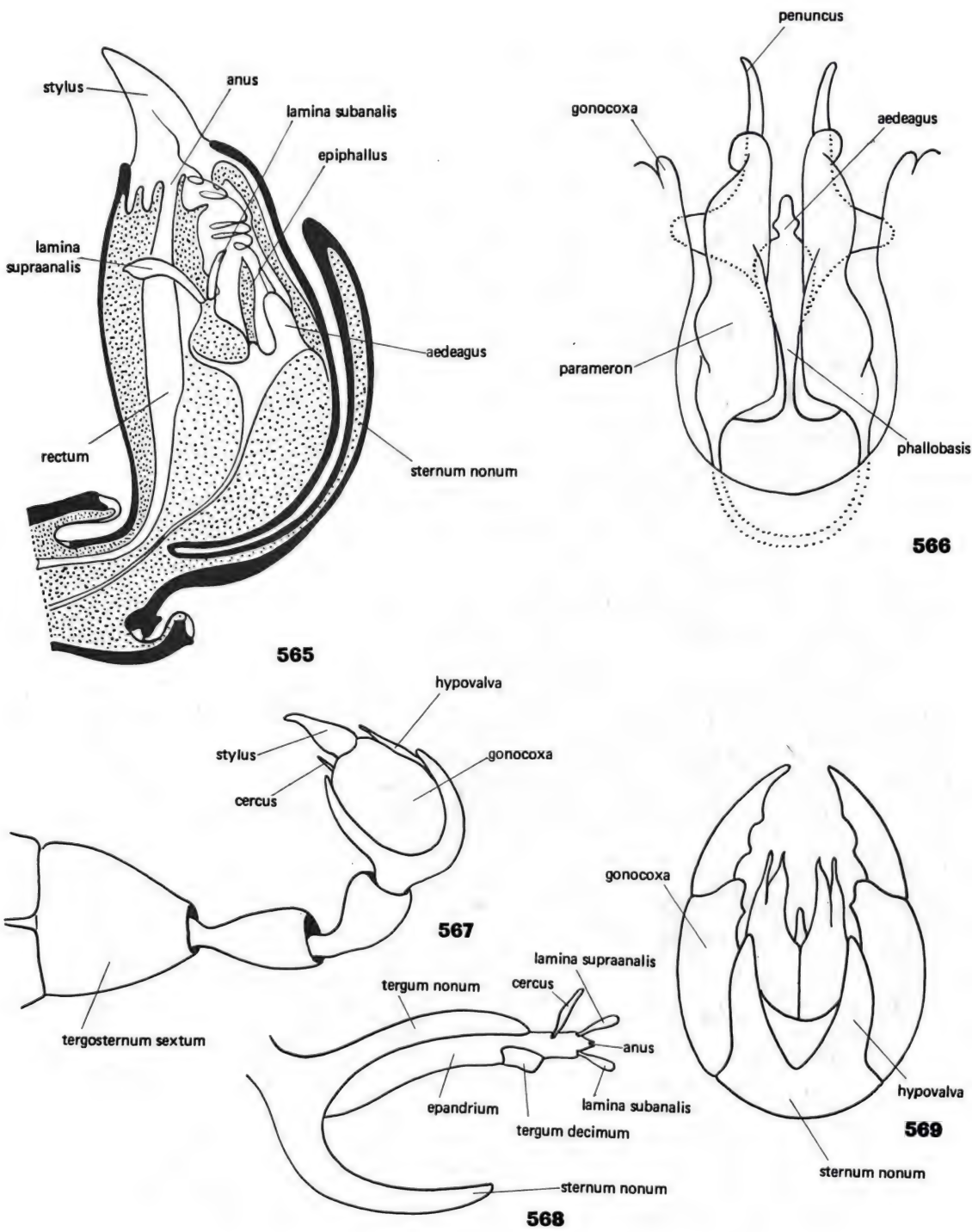
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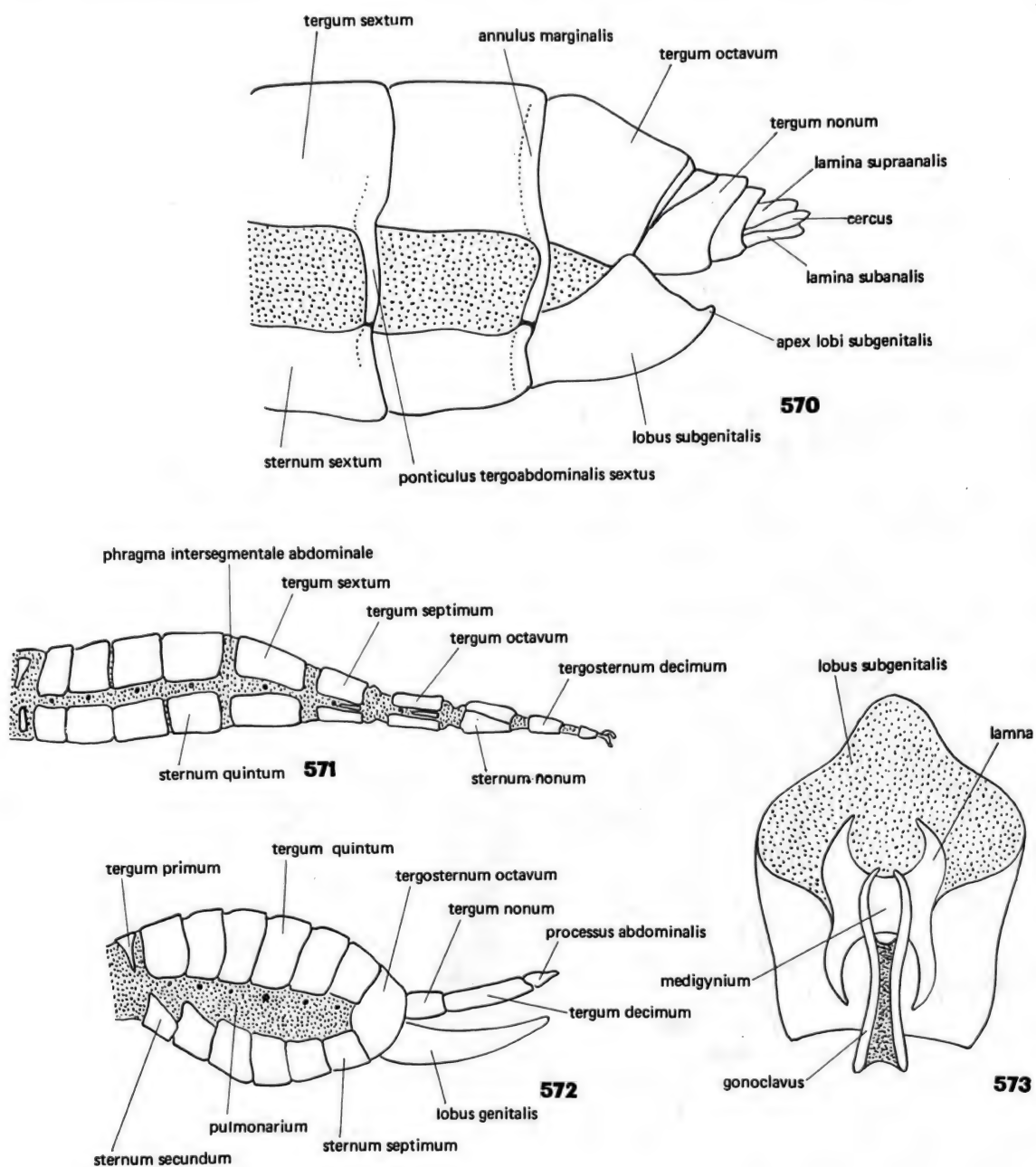
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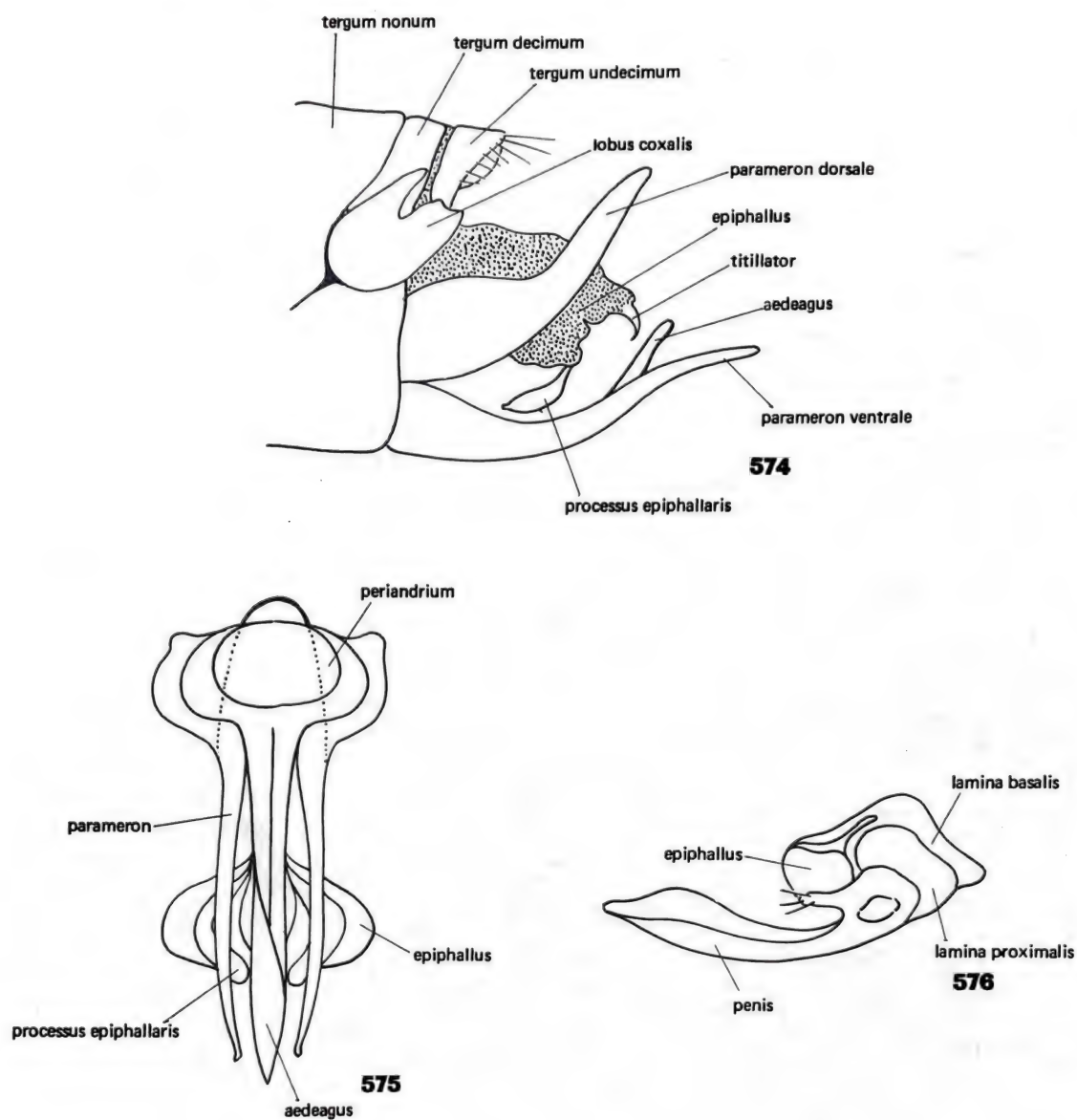
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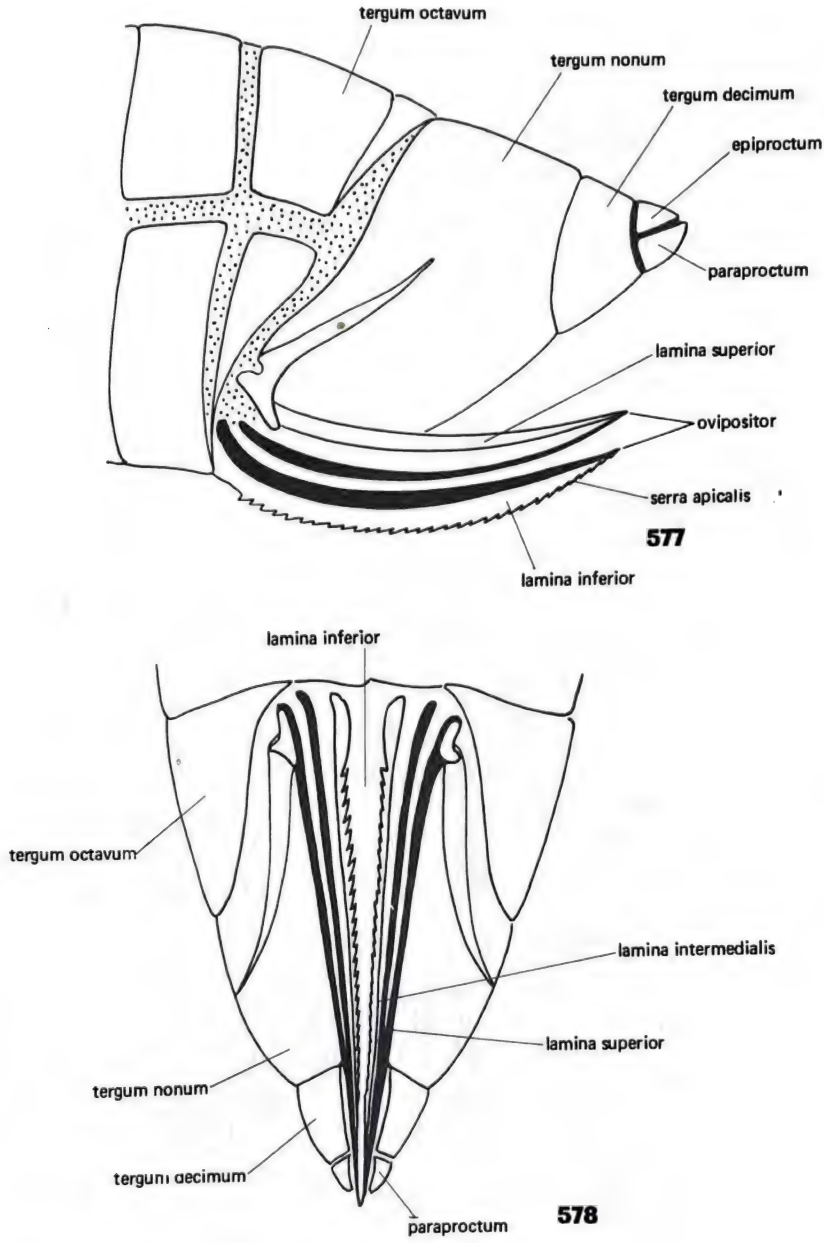
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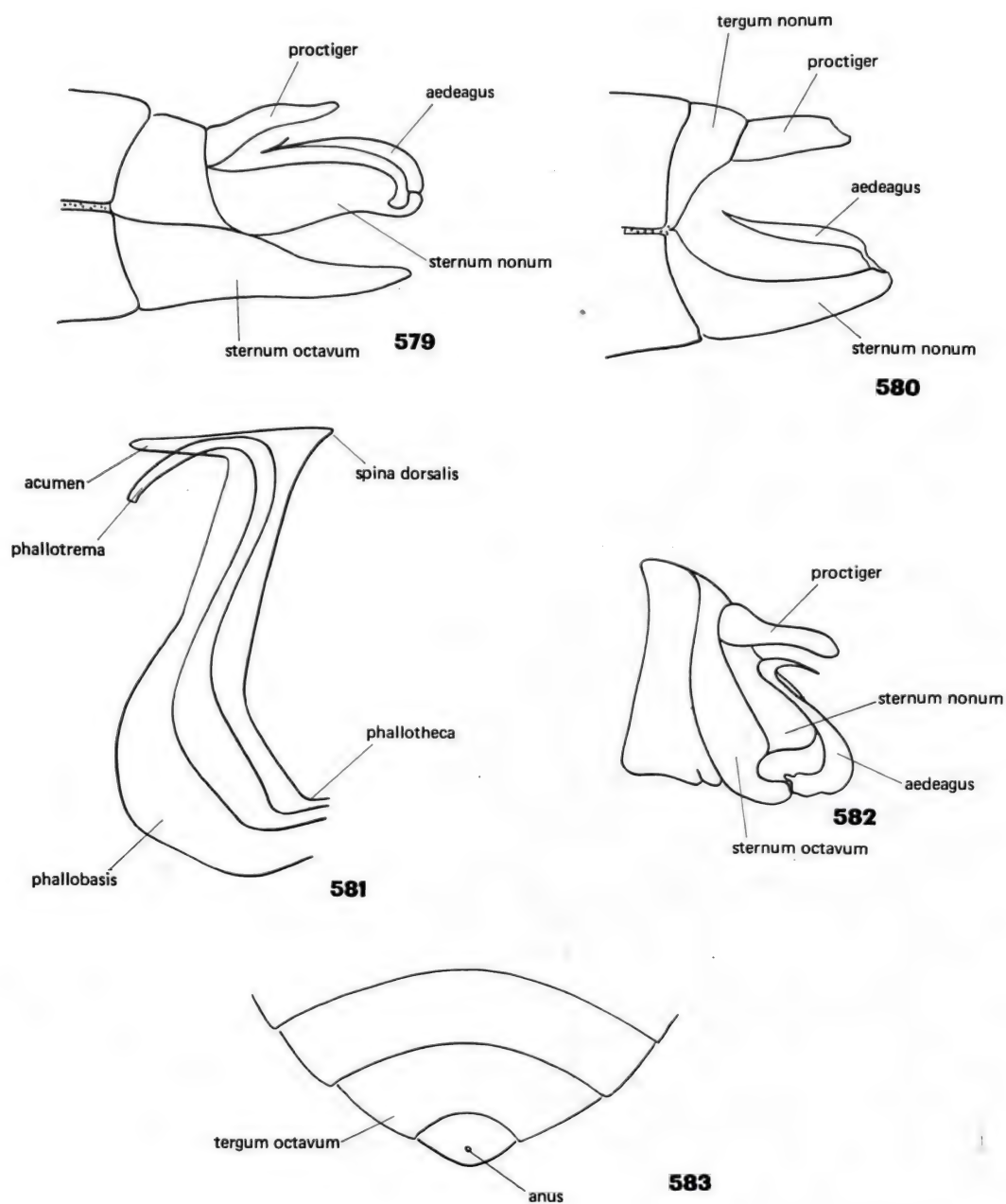
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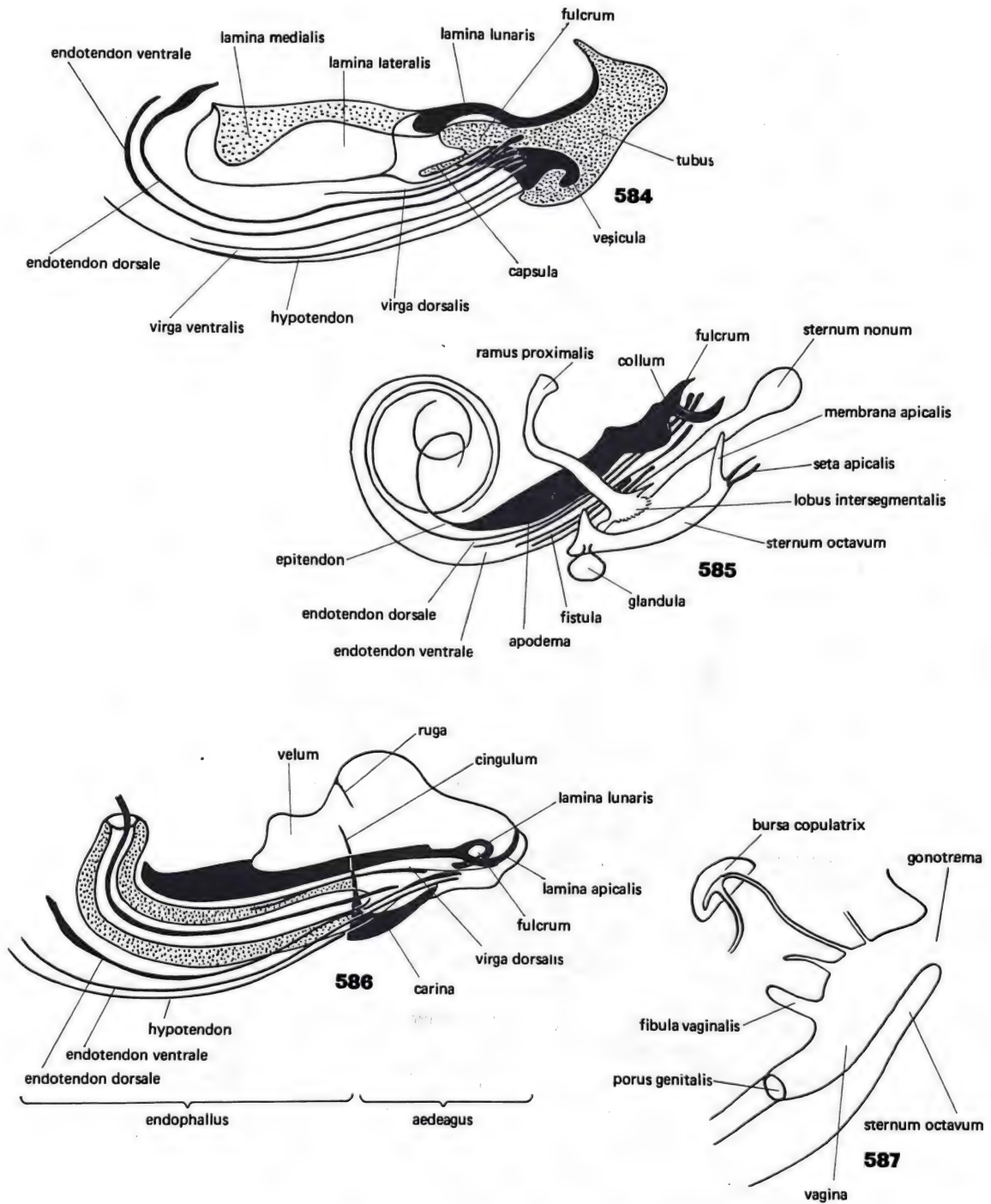
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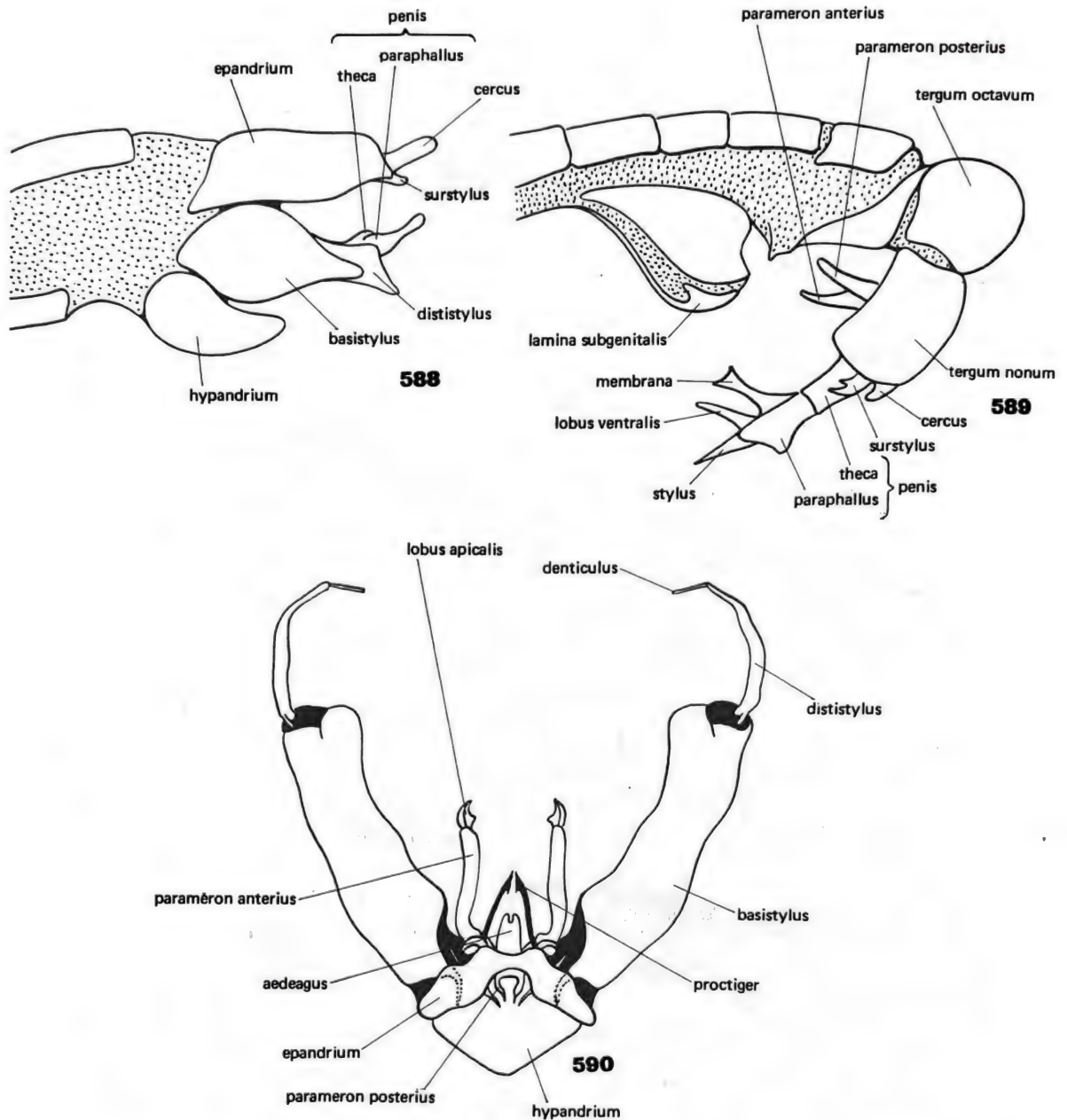
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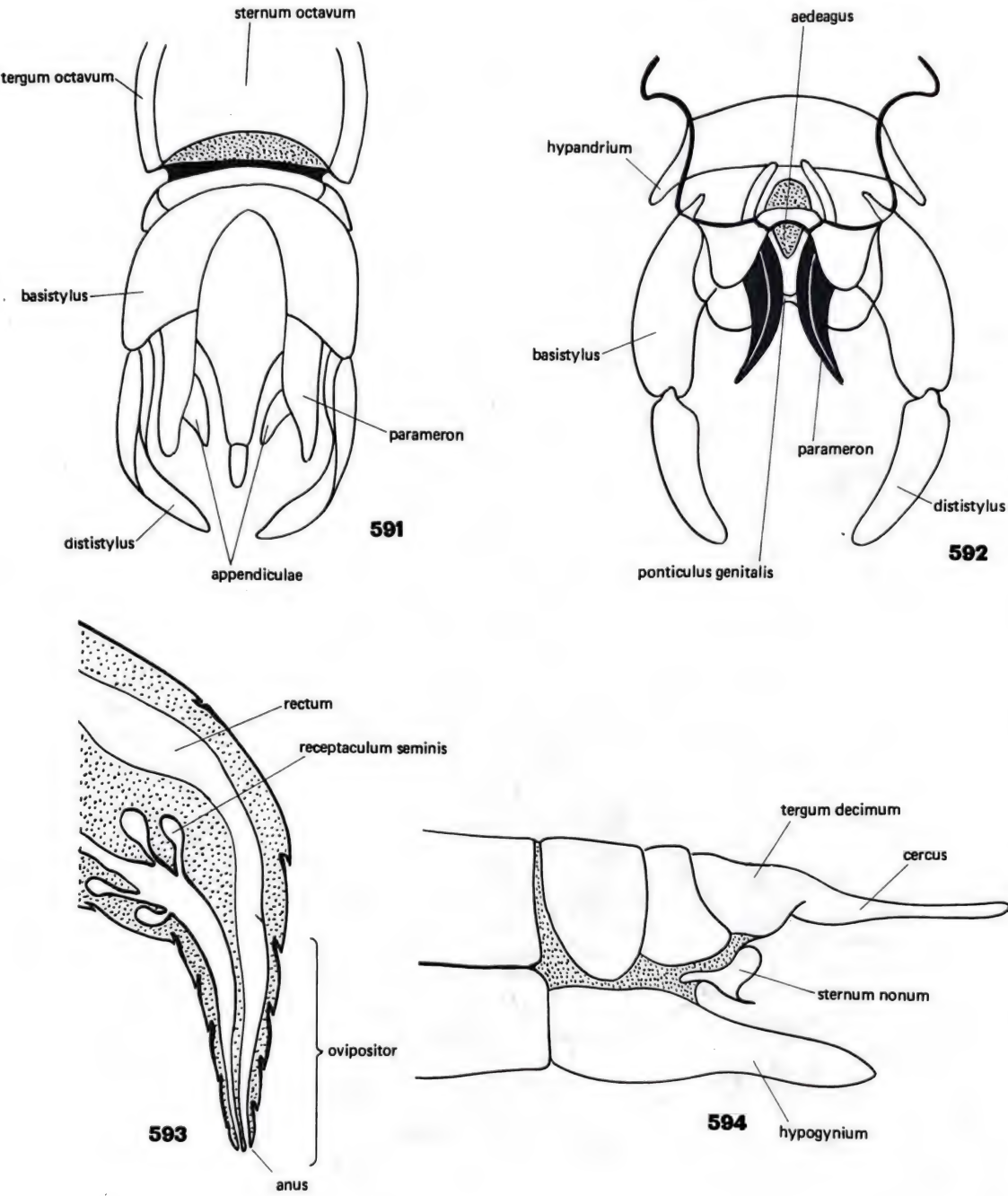
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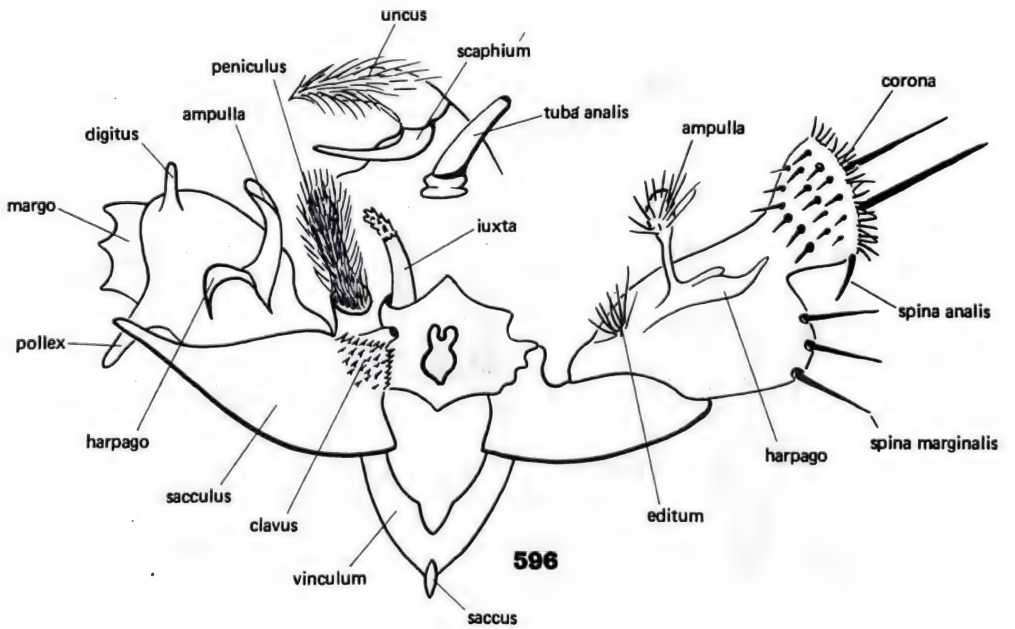
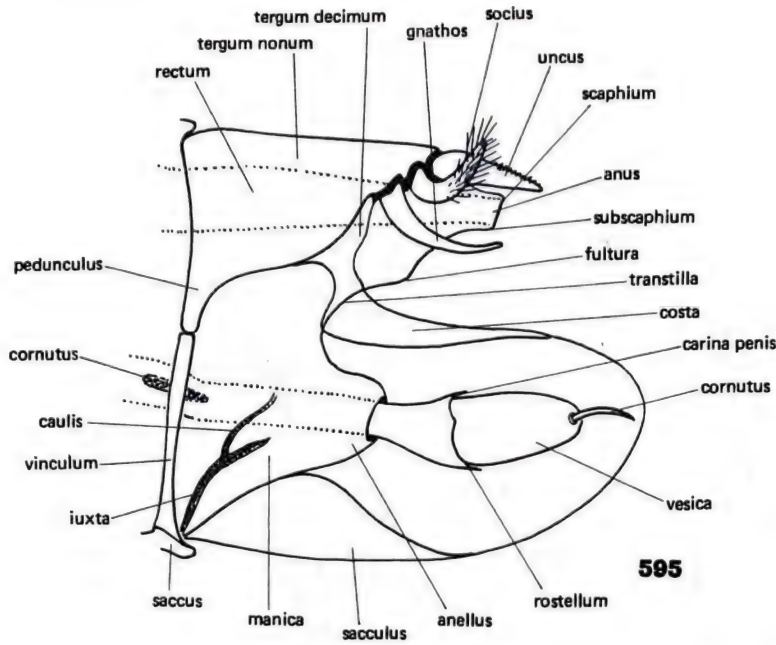
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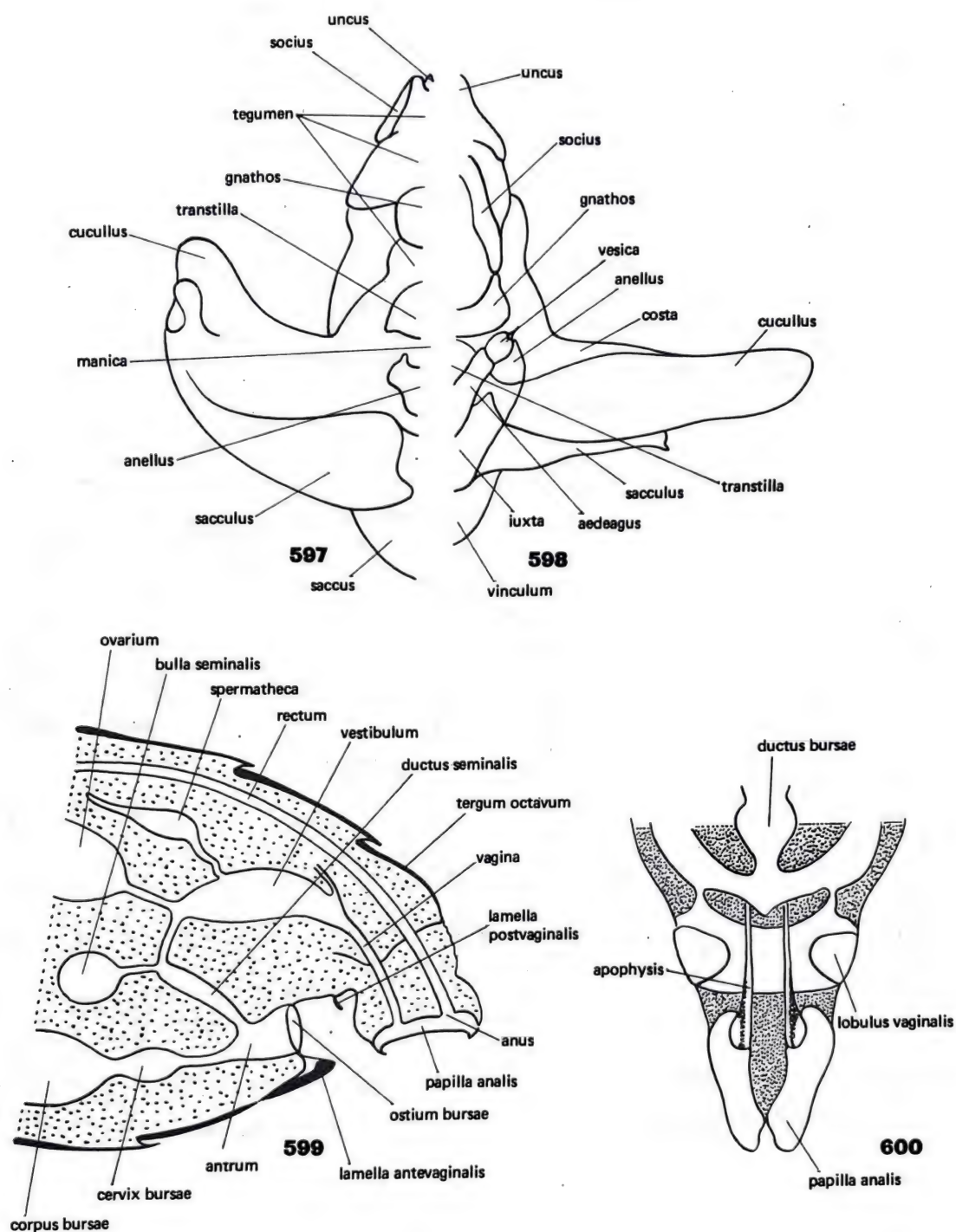
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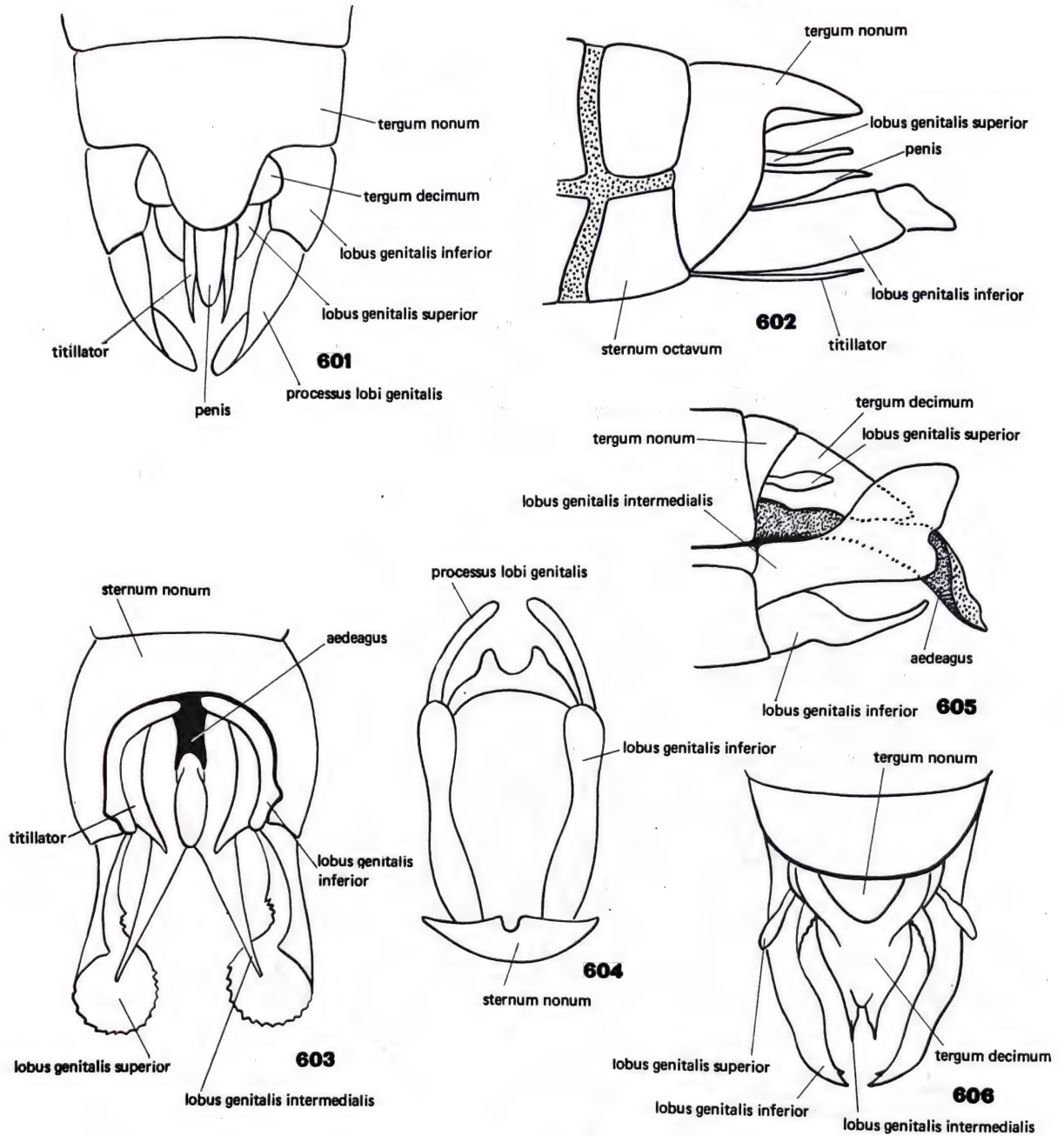
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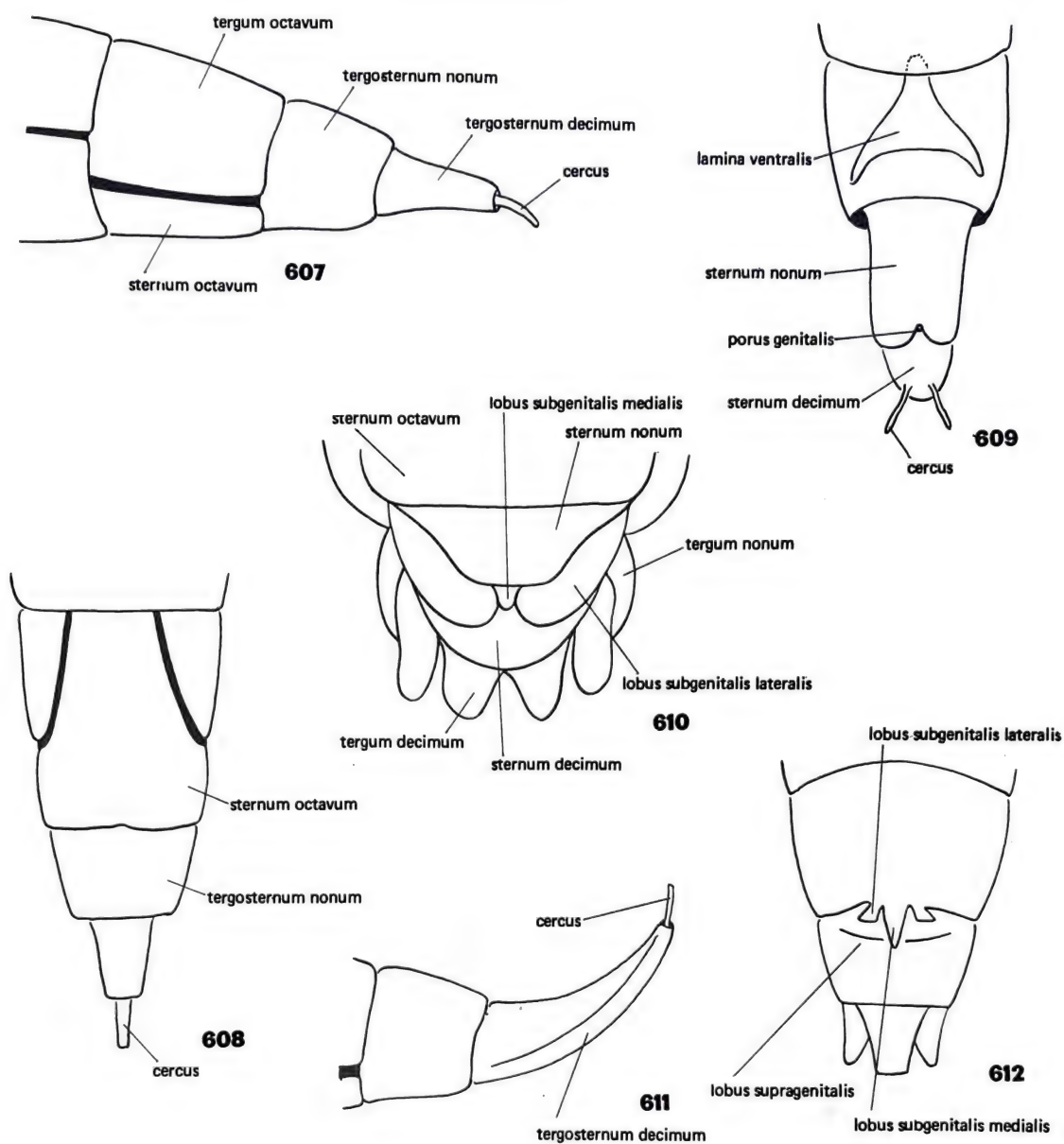
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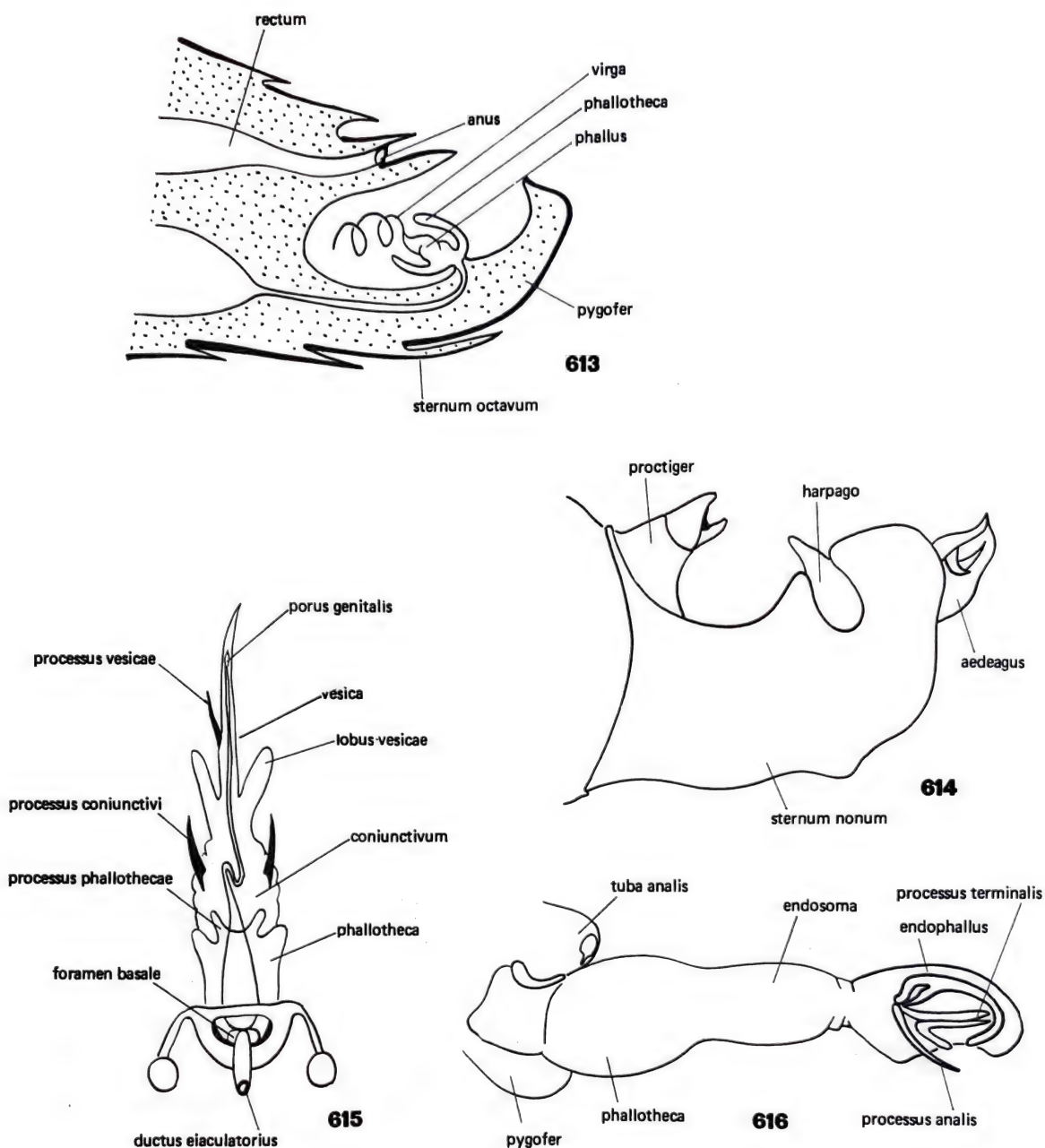
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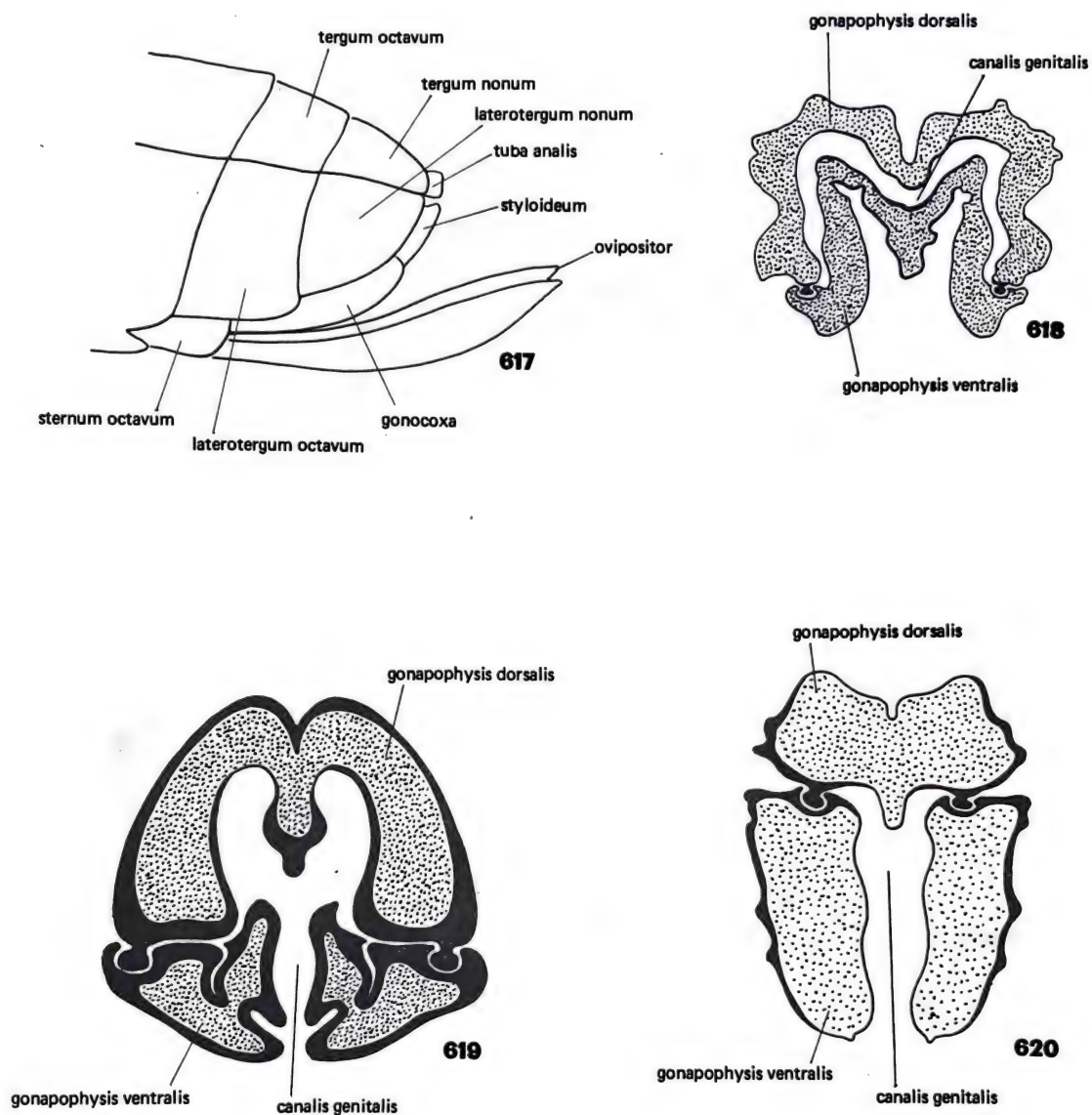
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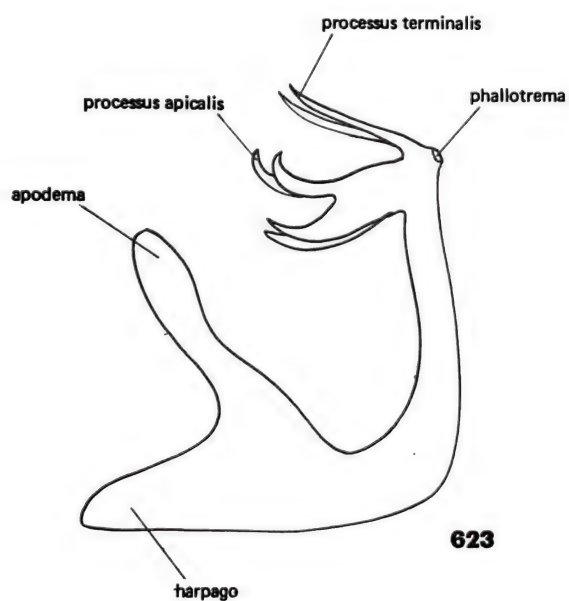
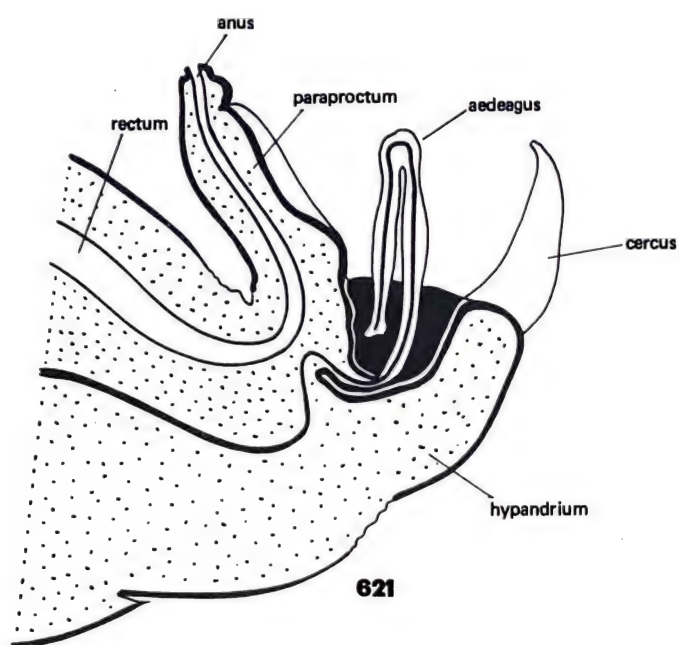
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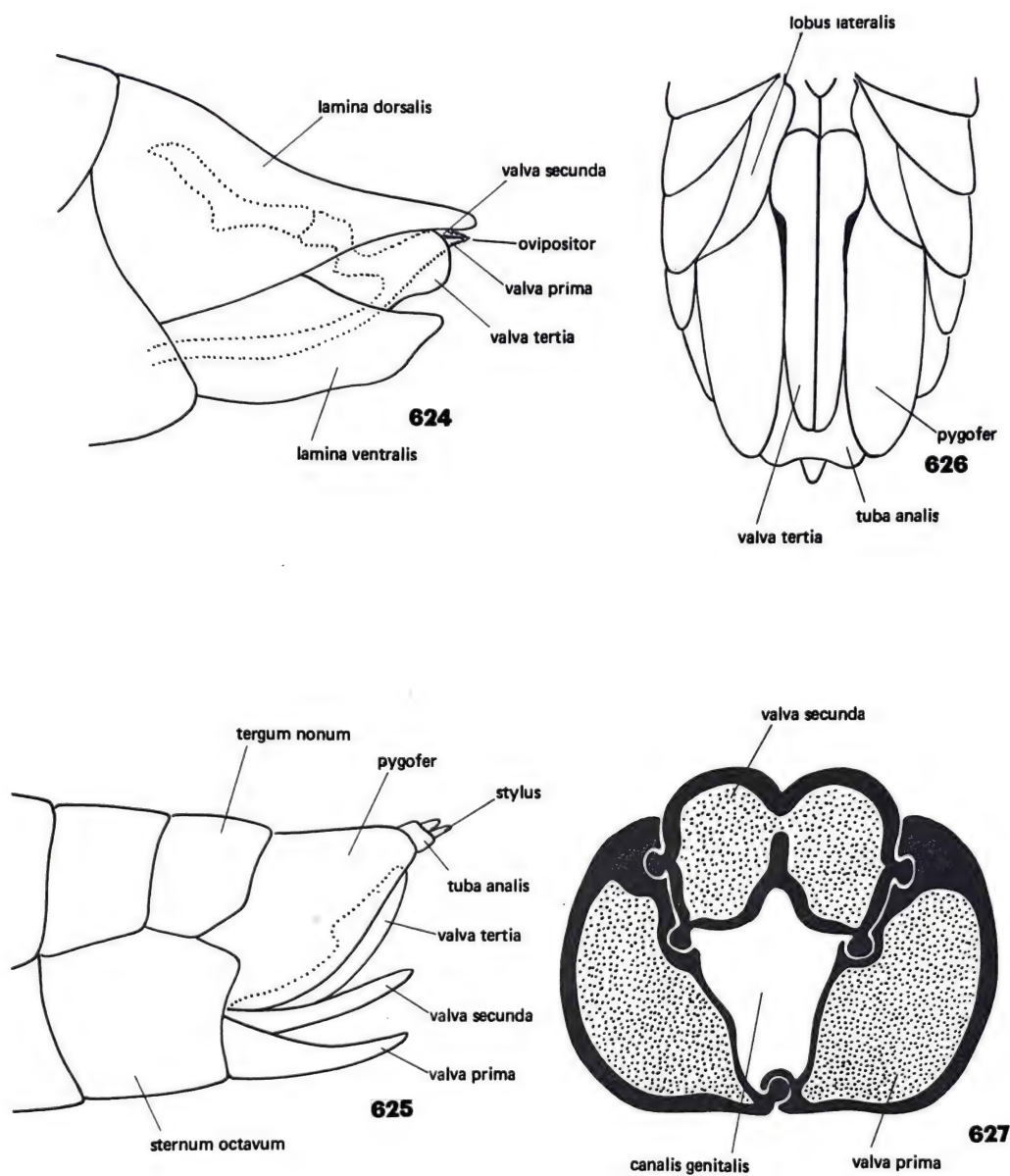
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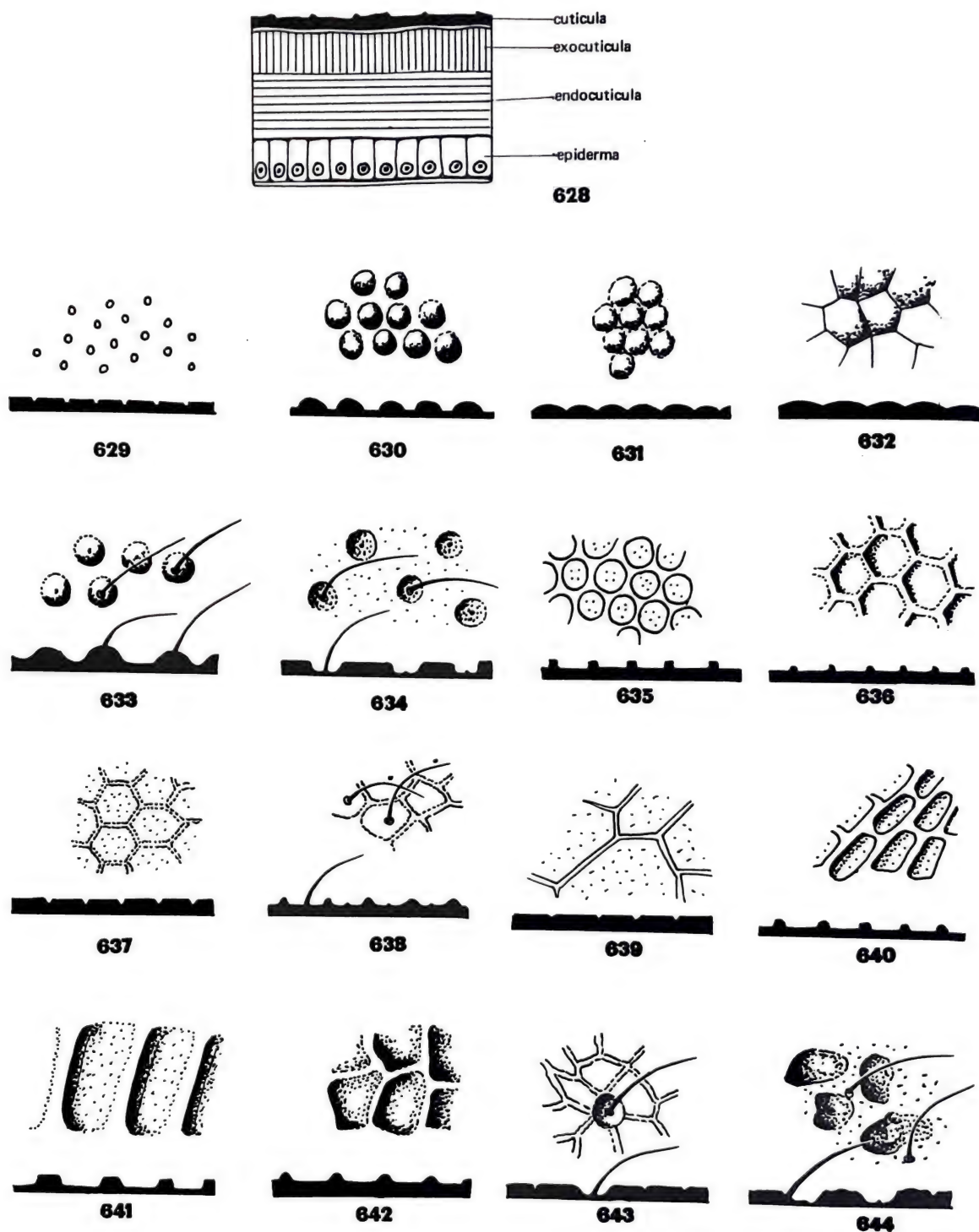


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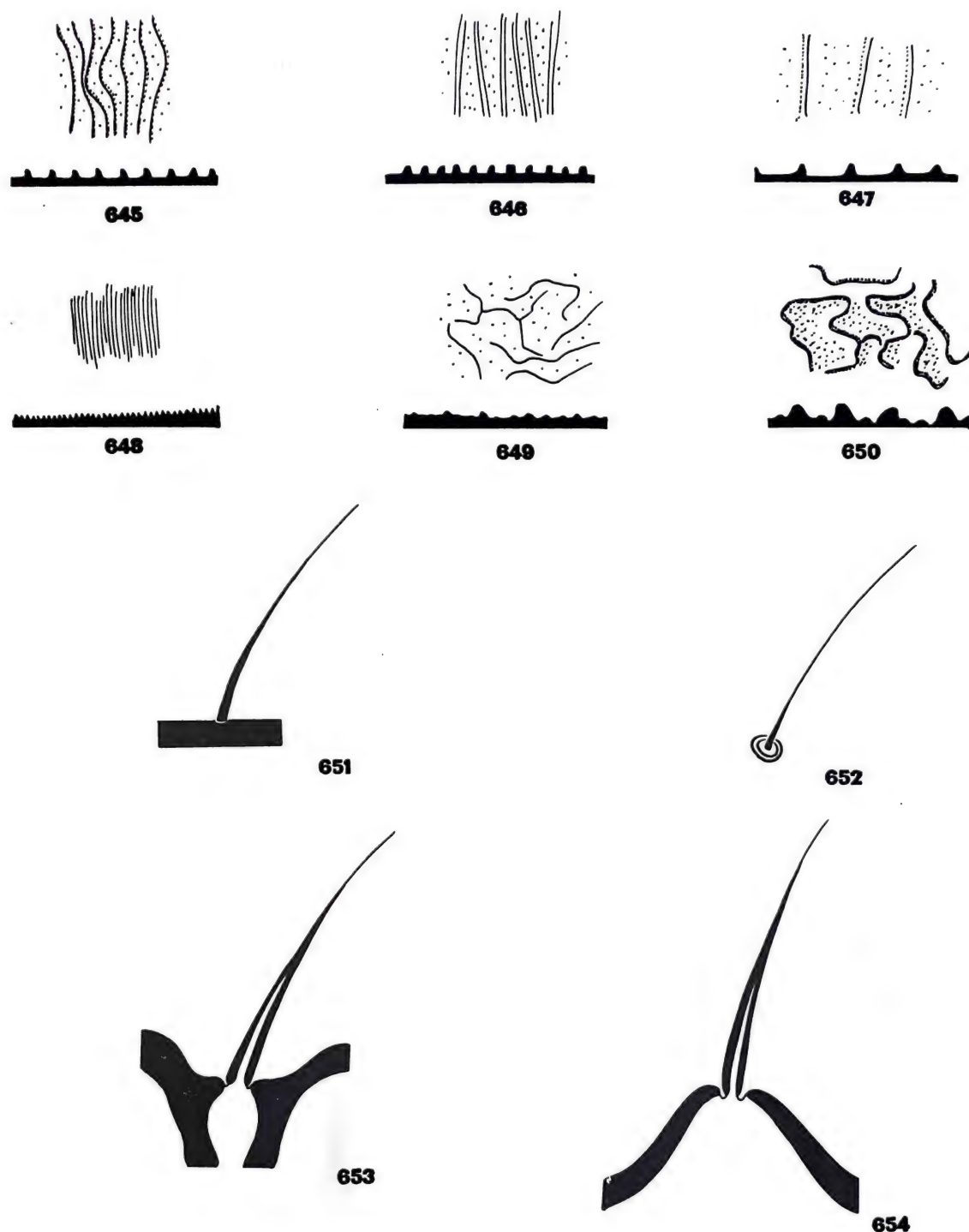


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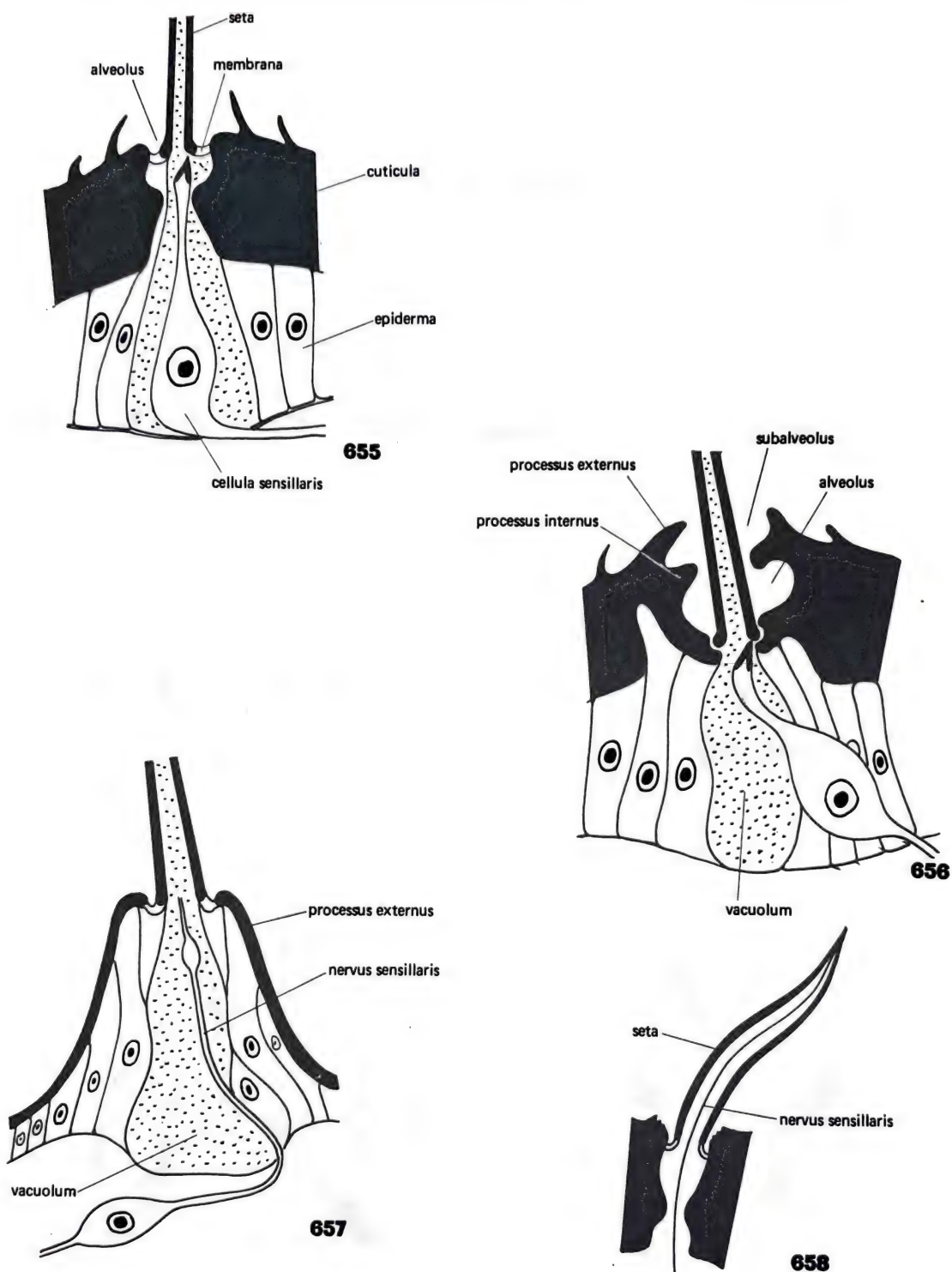
APPENDIX



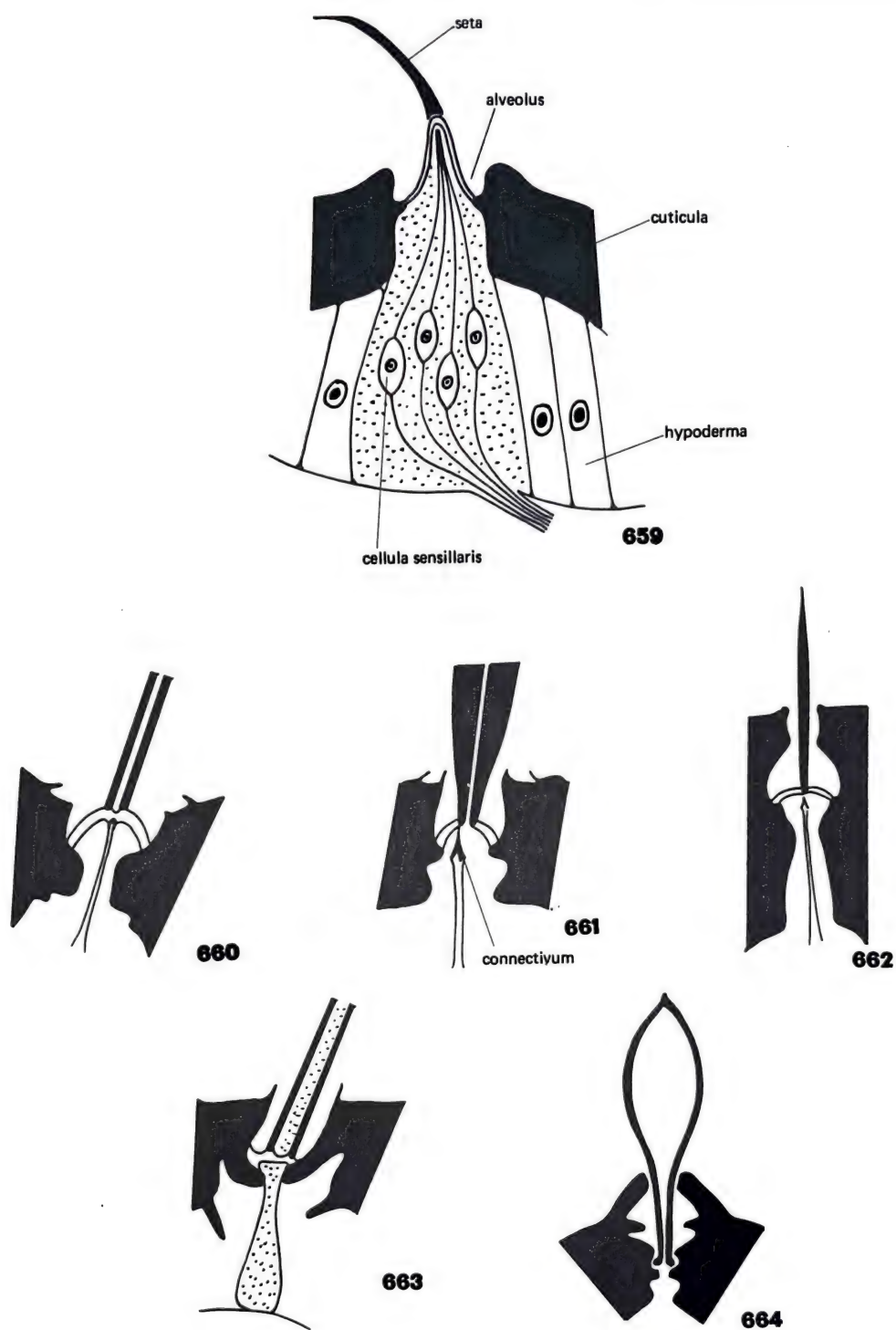
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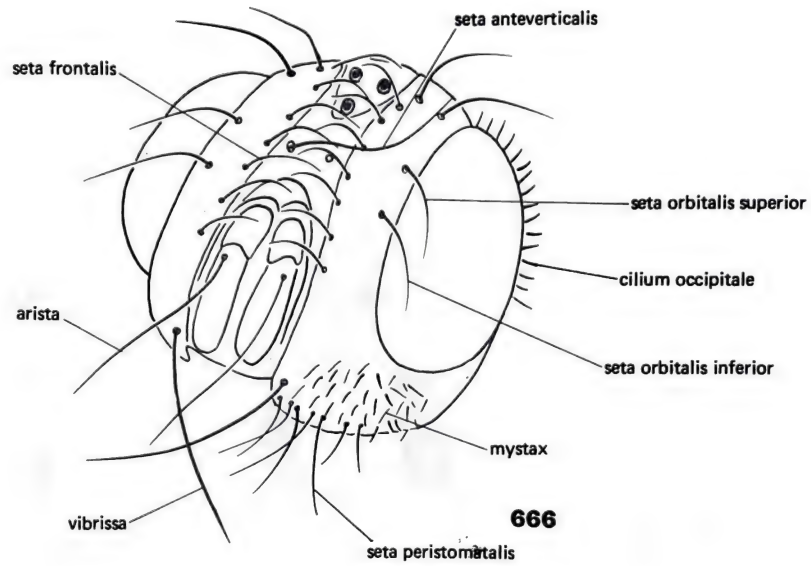
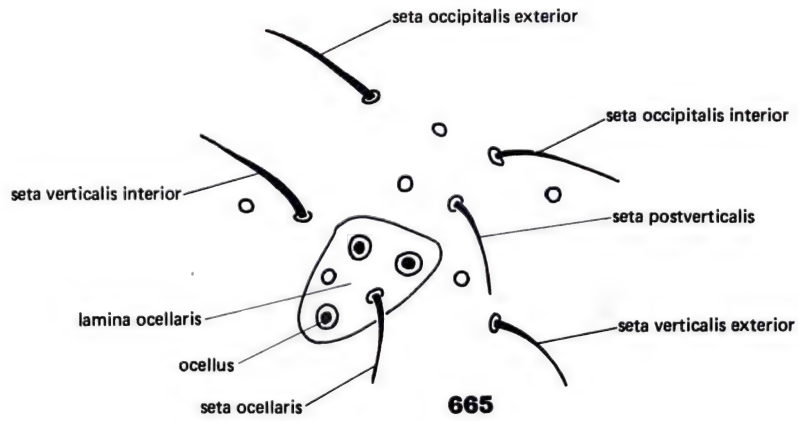
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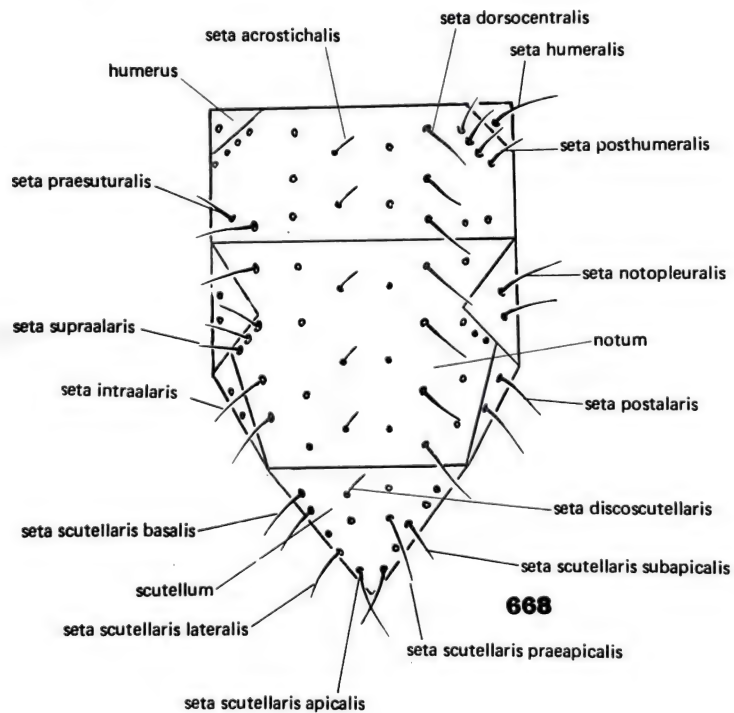
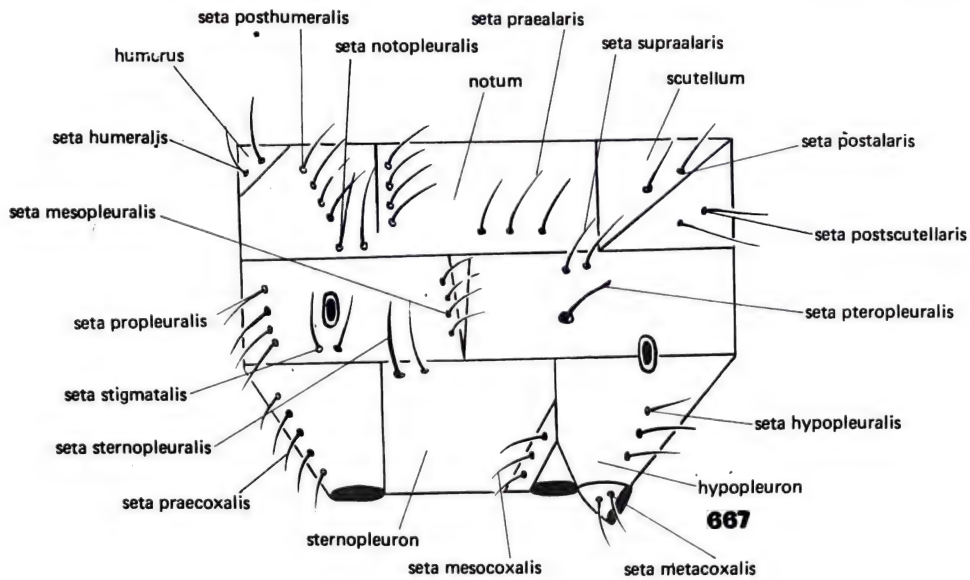
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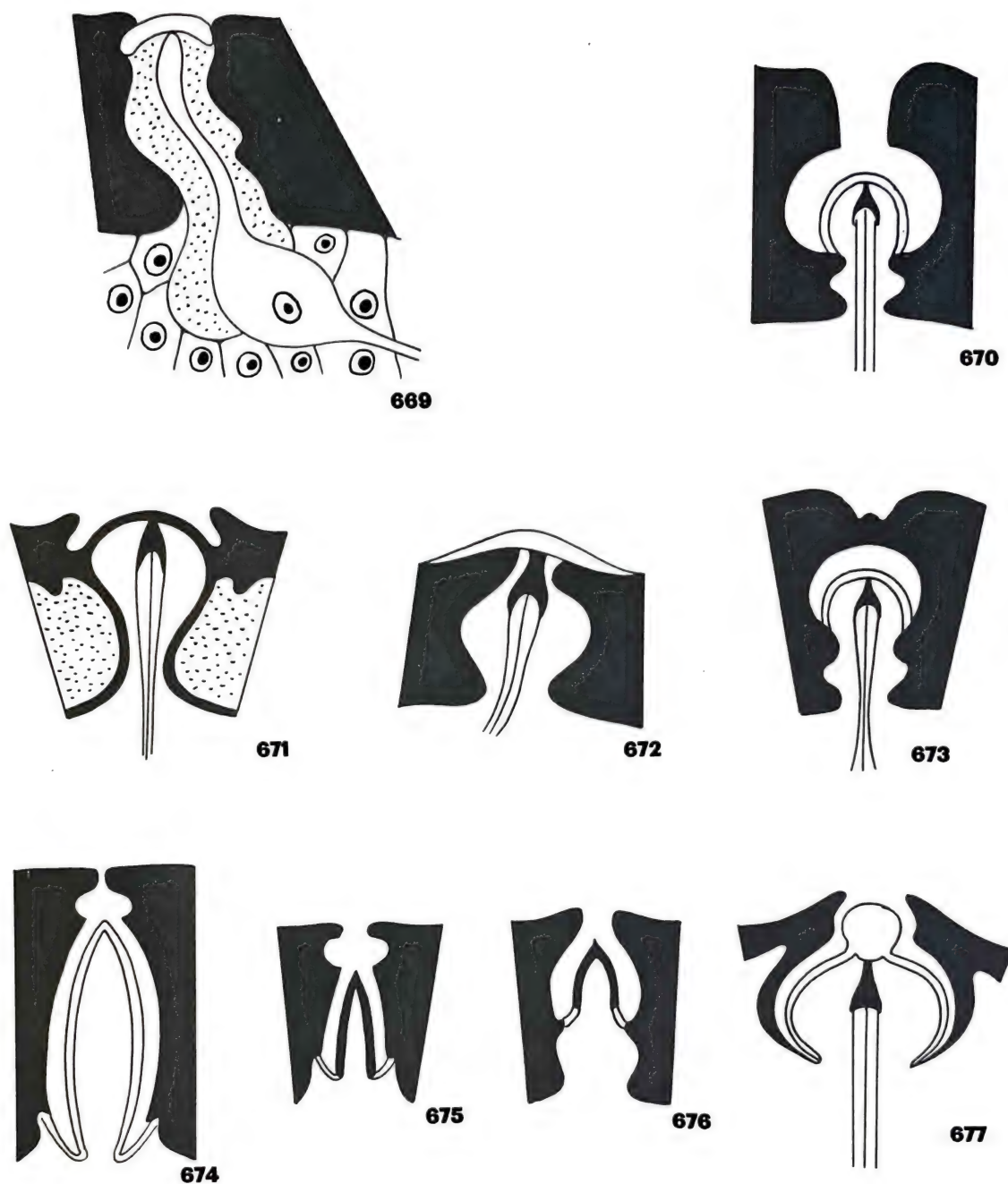
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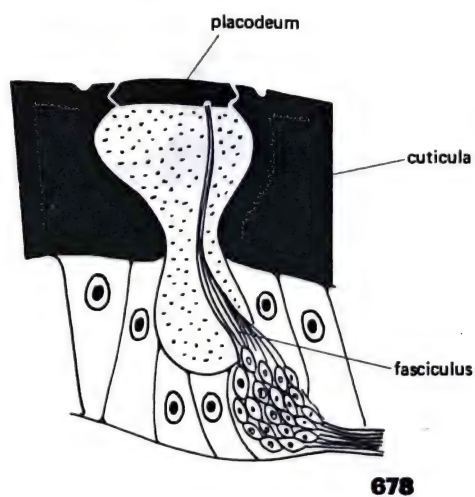
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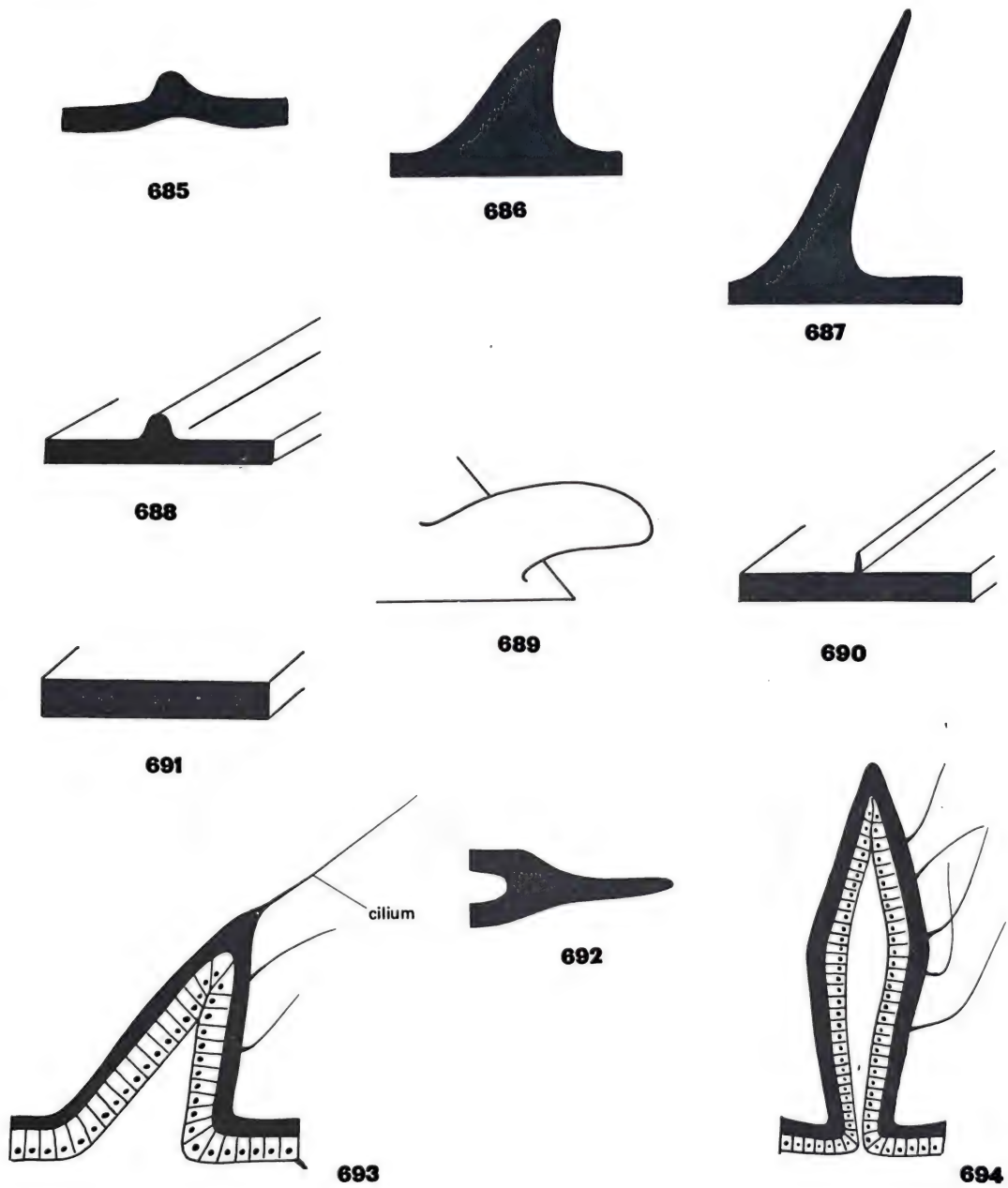
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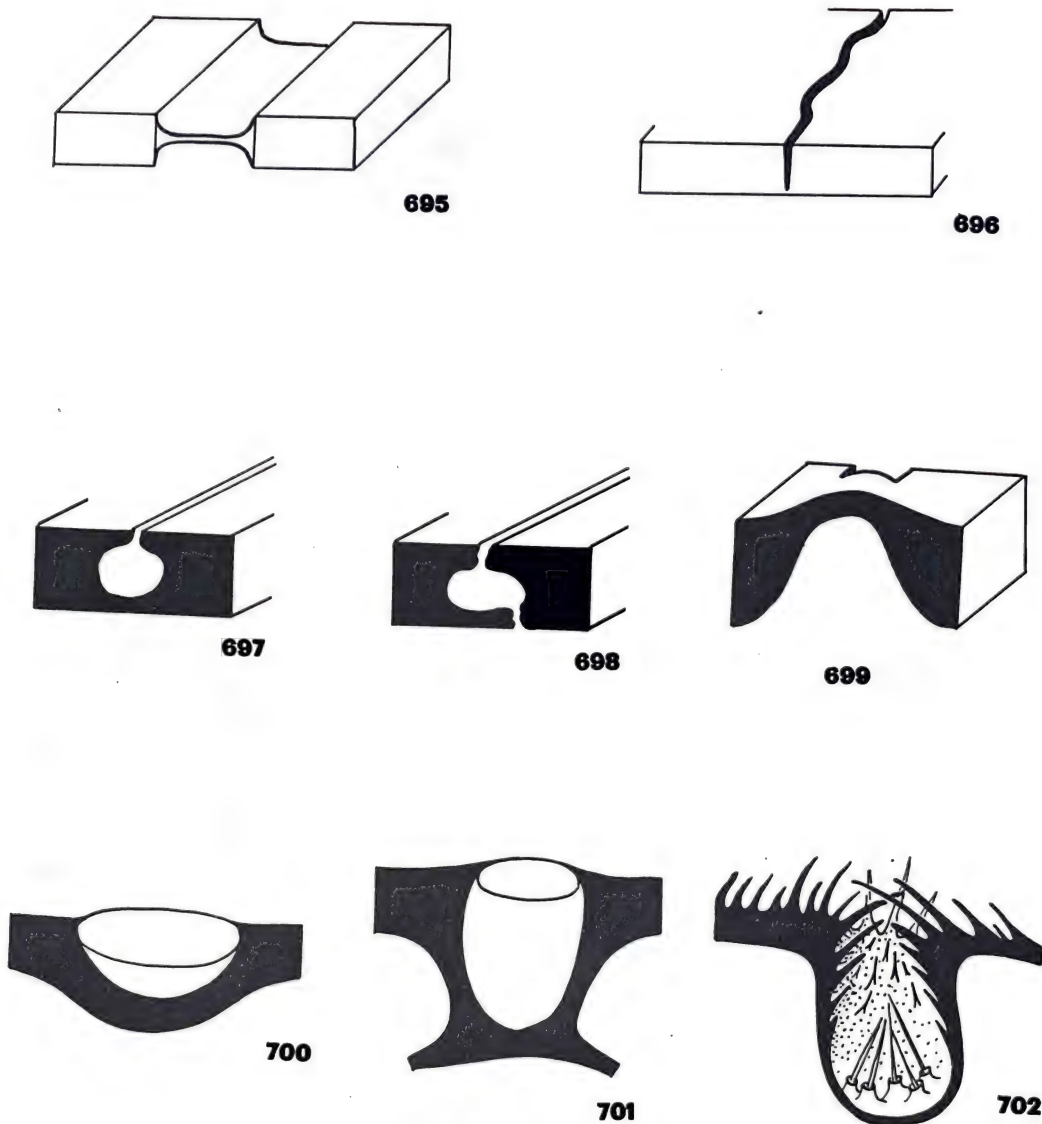
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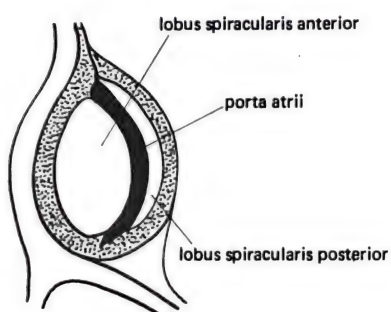
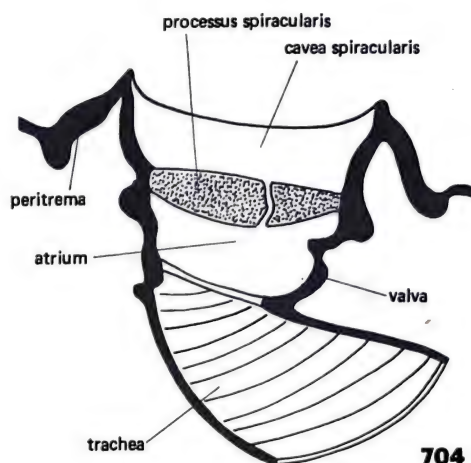
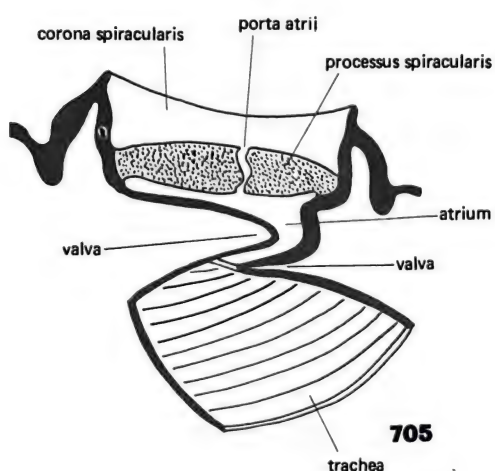
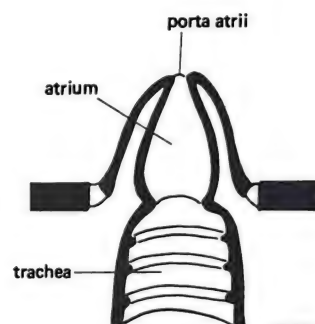
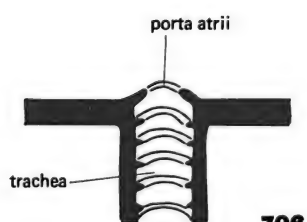
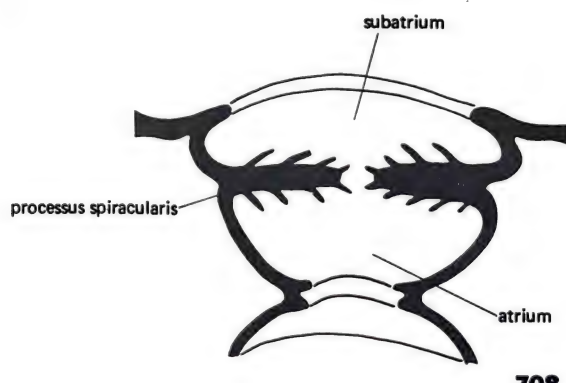
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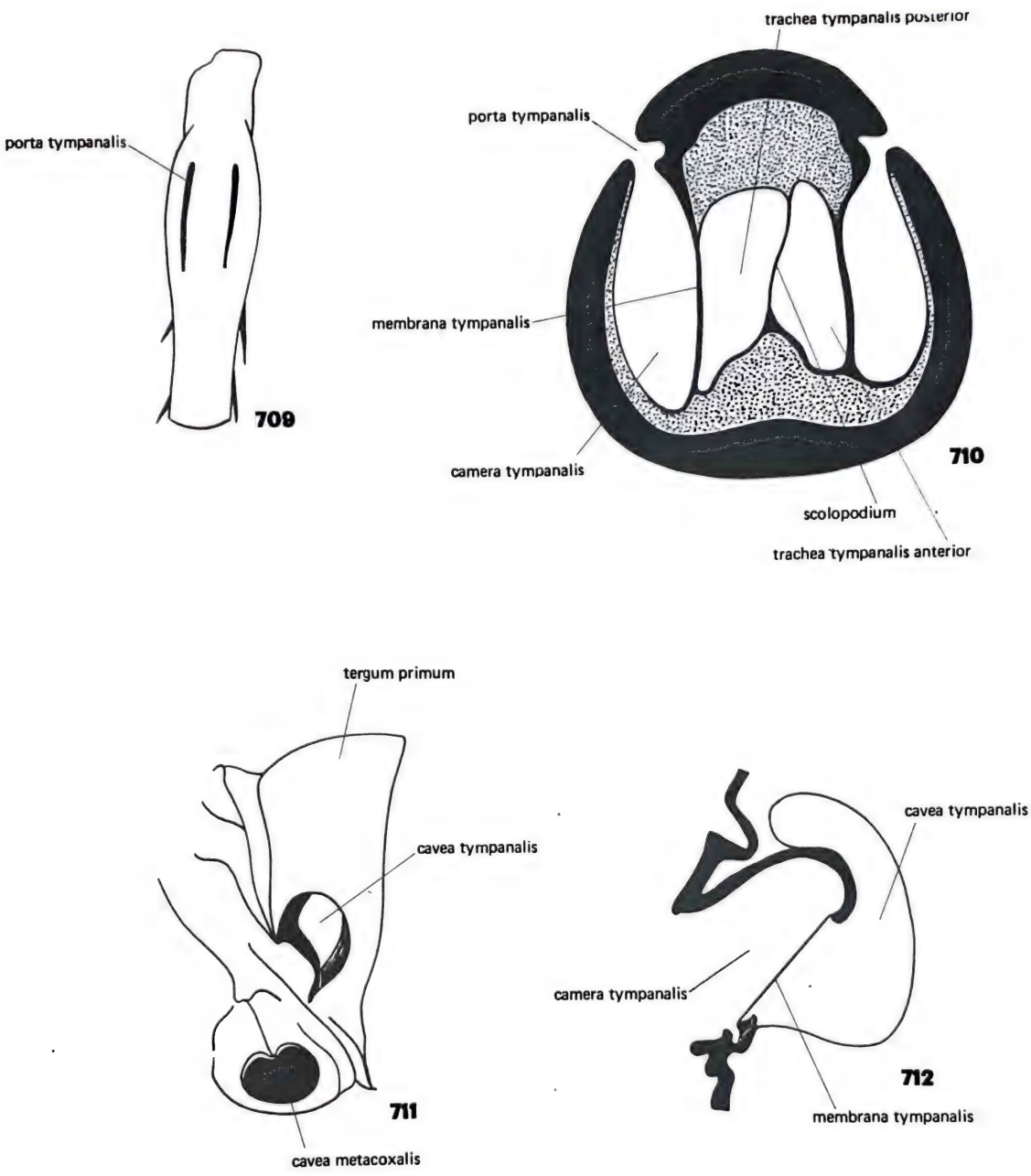
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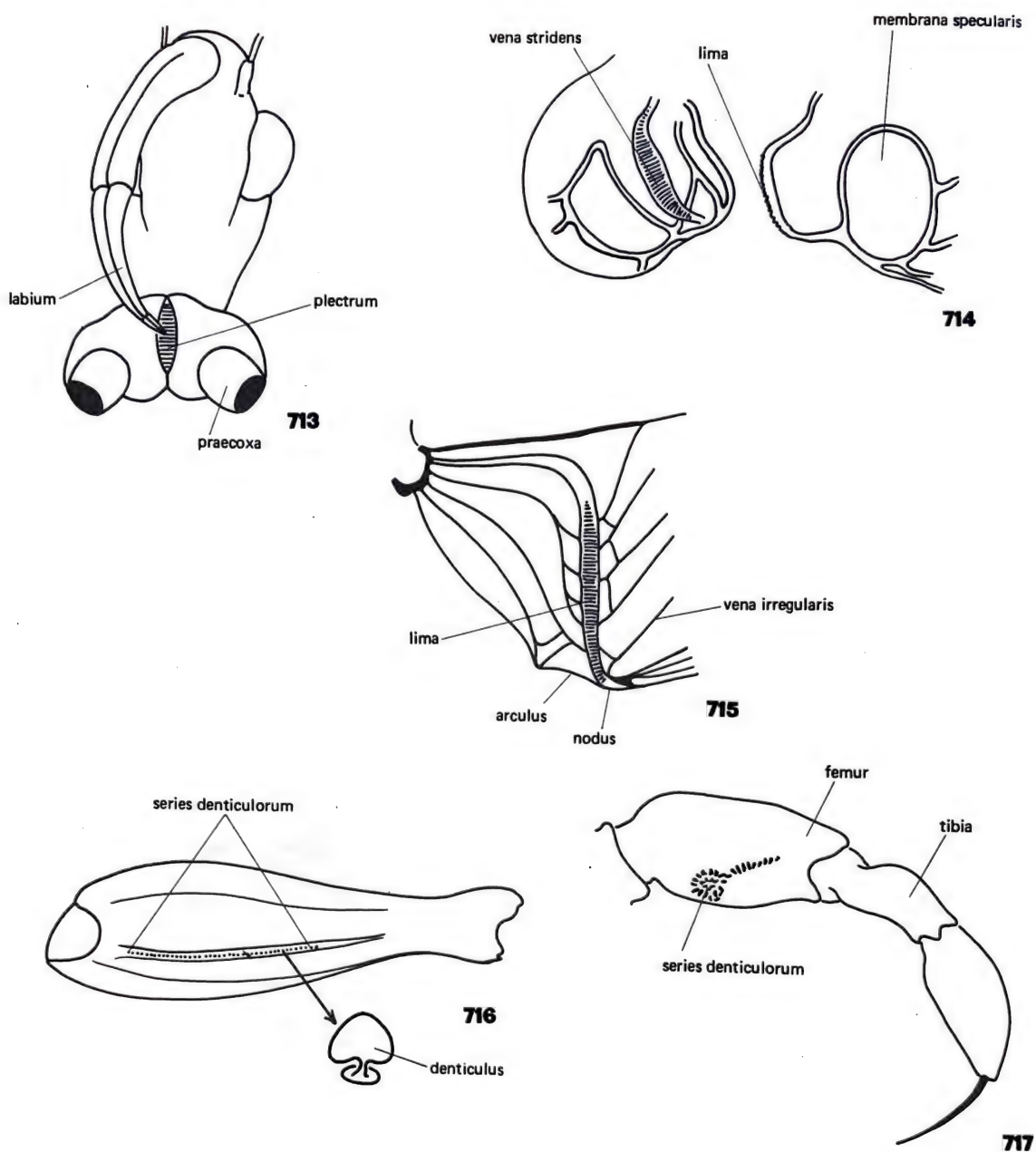
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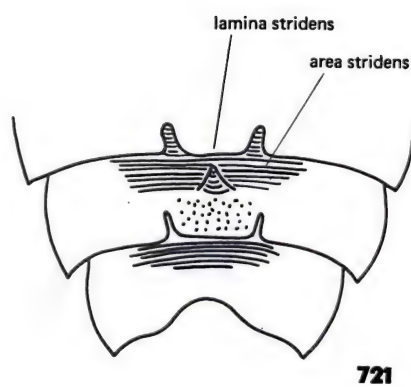
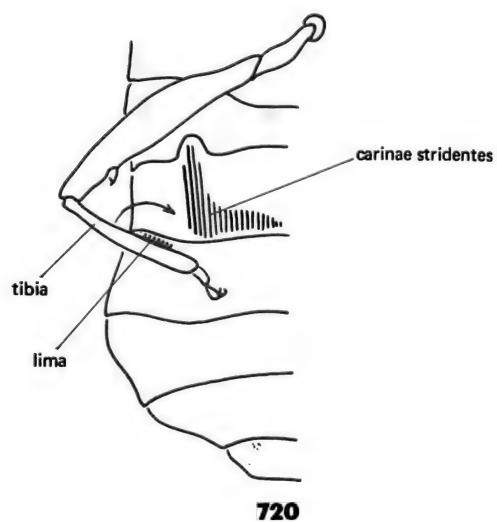
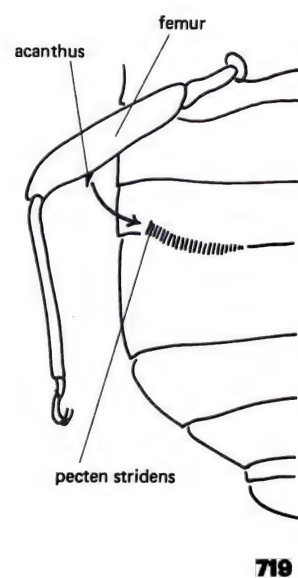
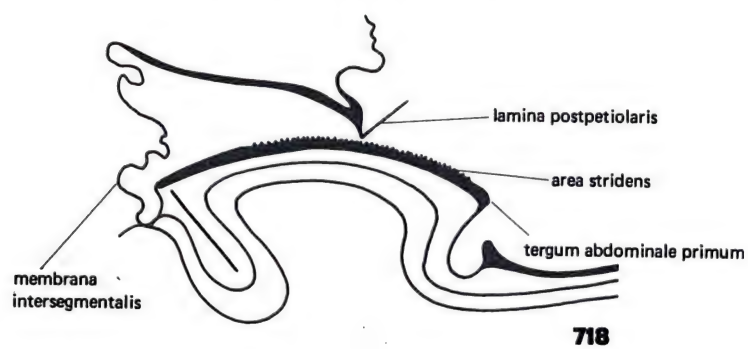
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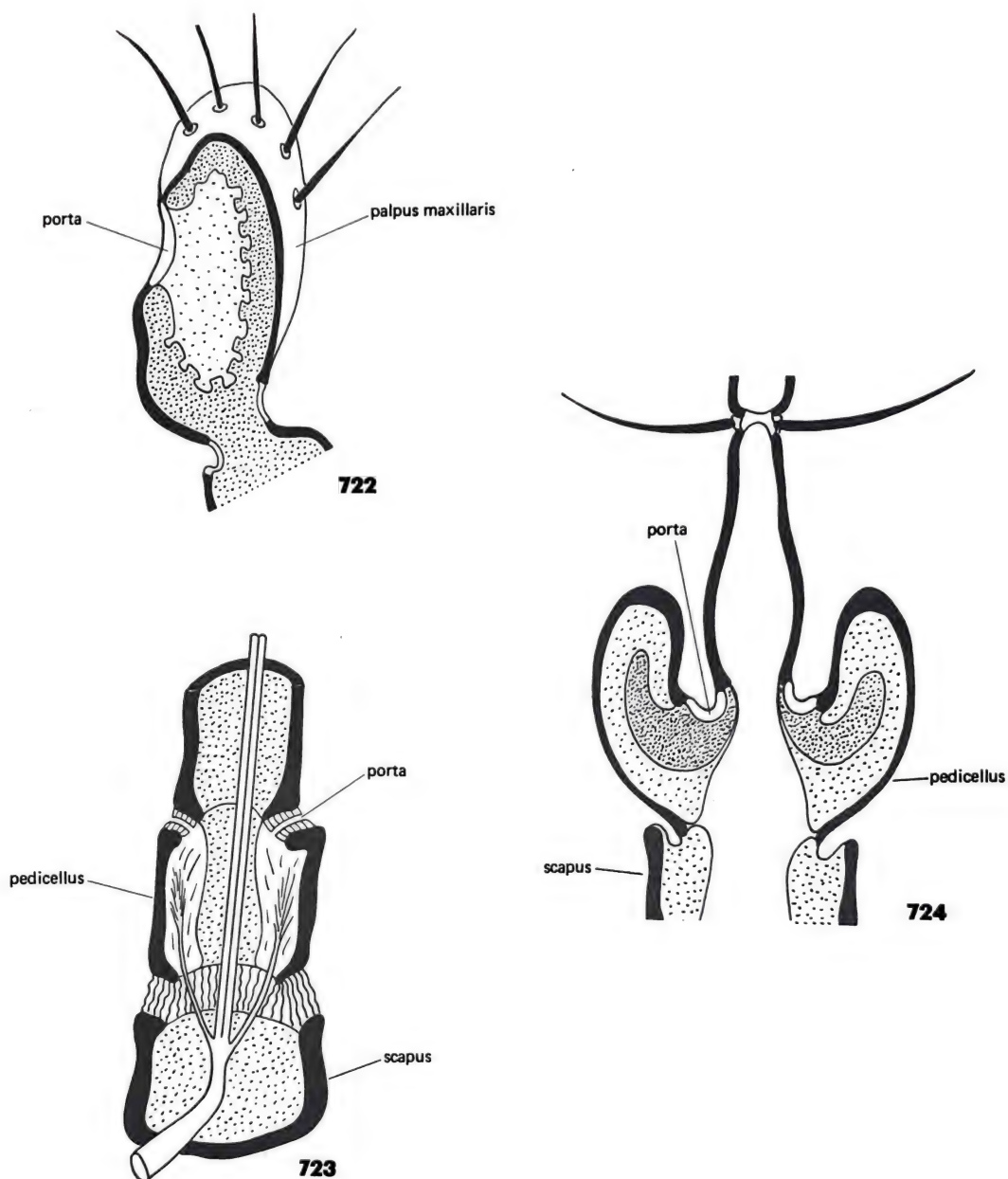
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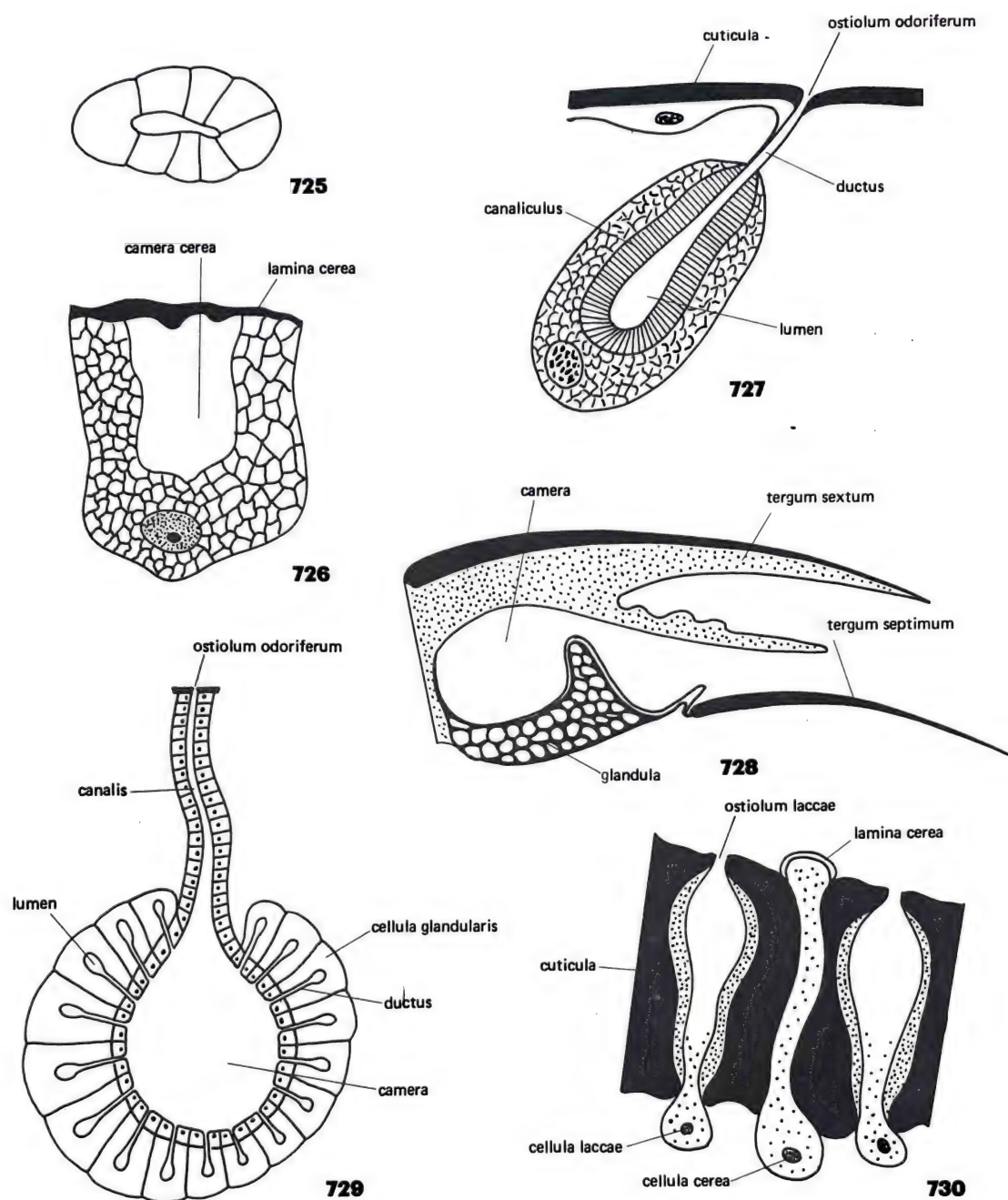
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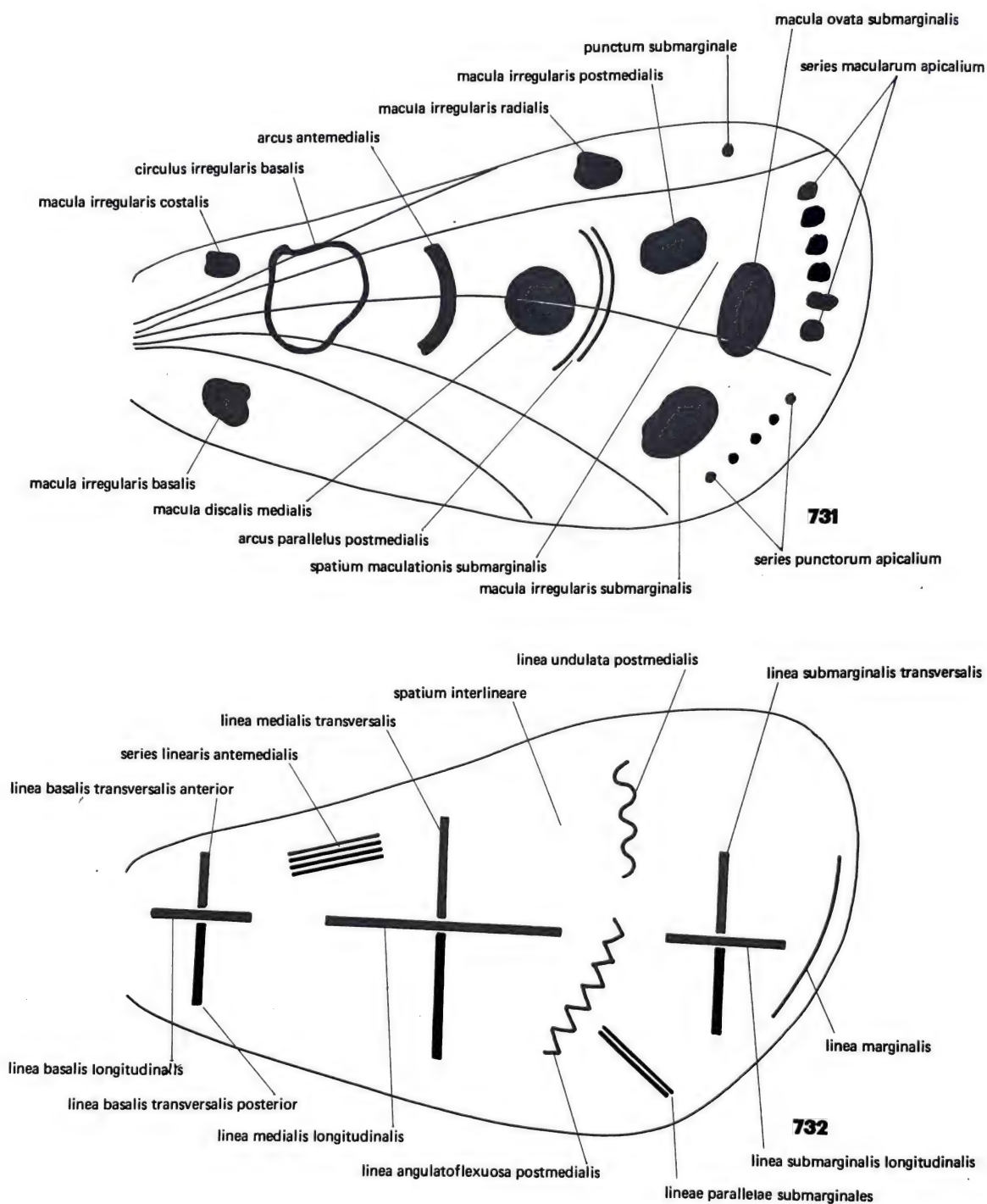
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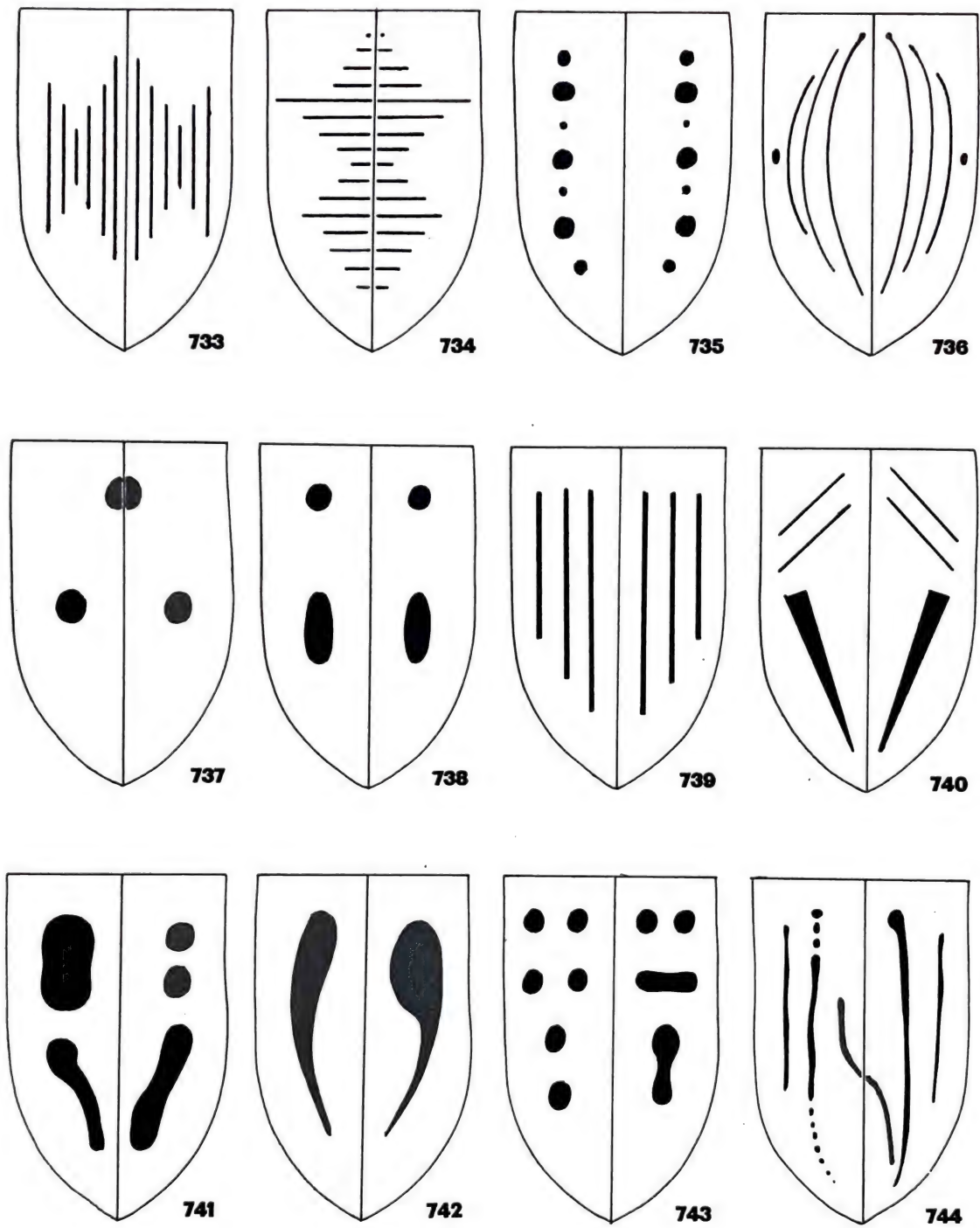
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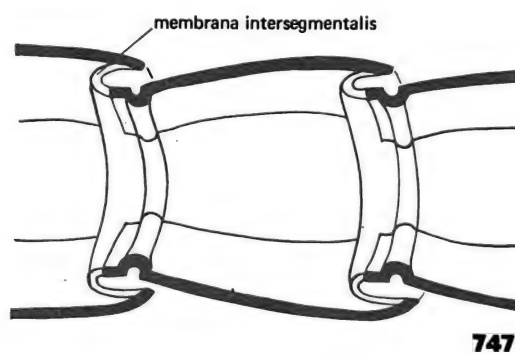
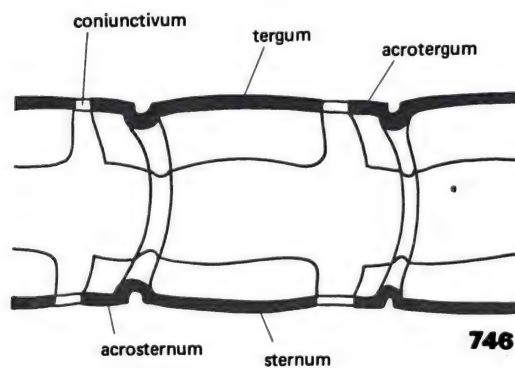
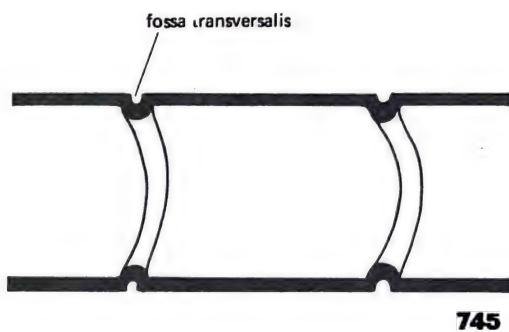
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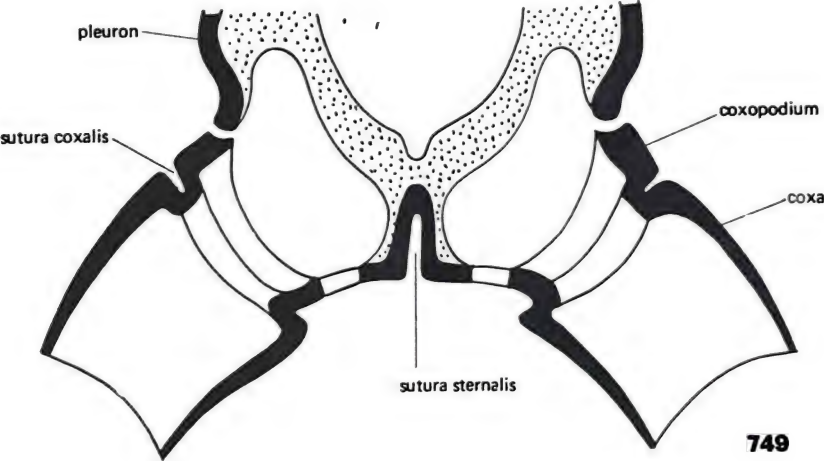
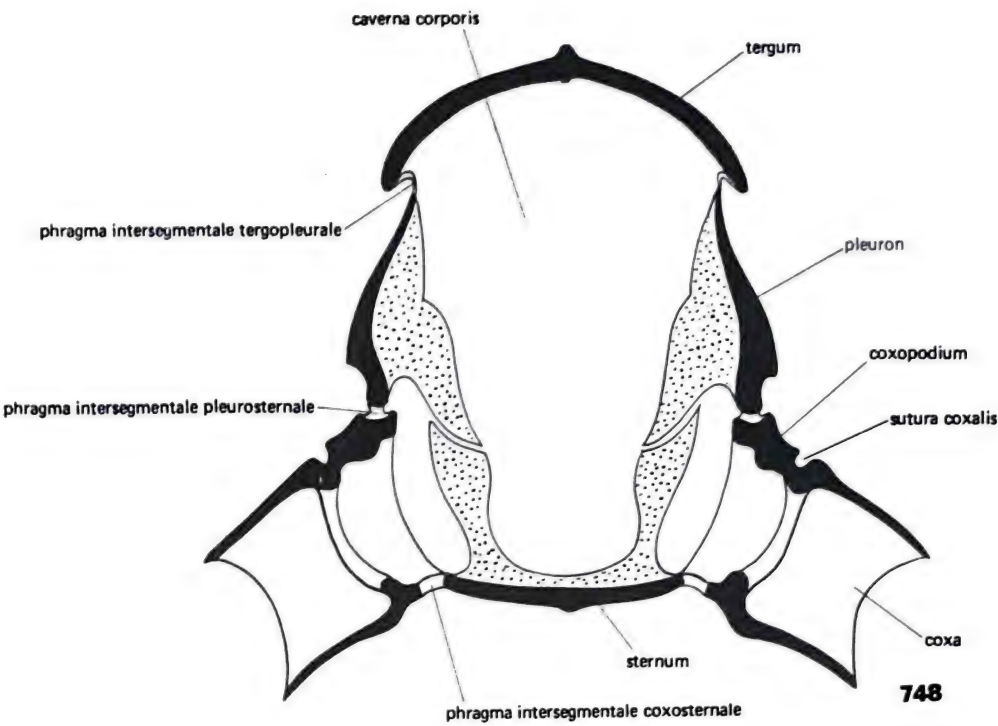
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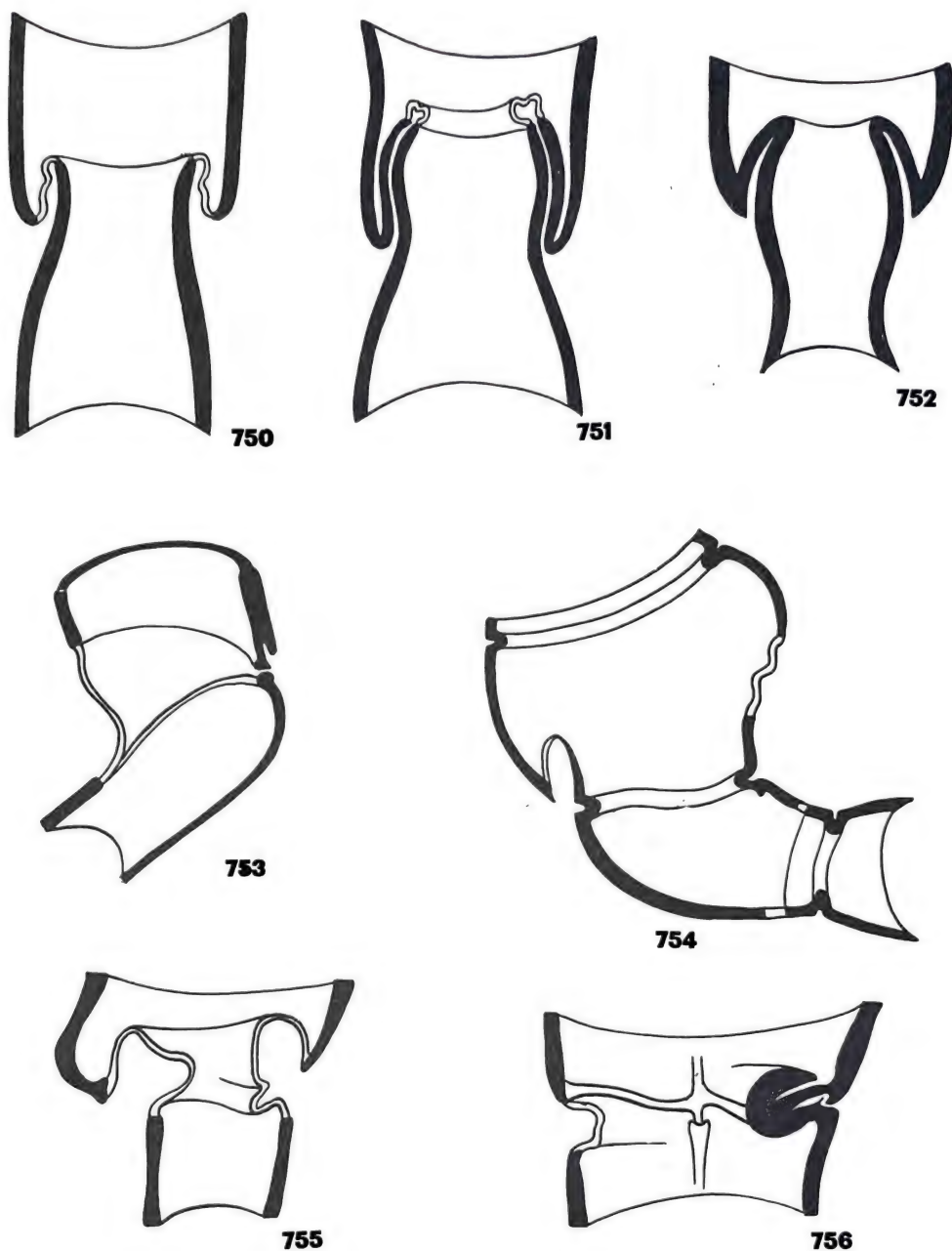
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cercina → stylus

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